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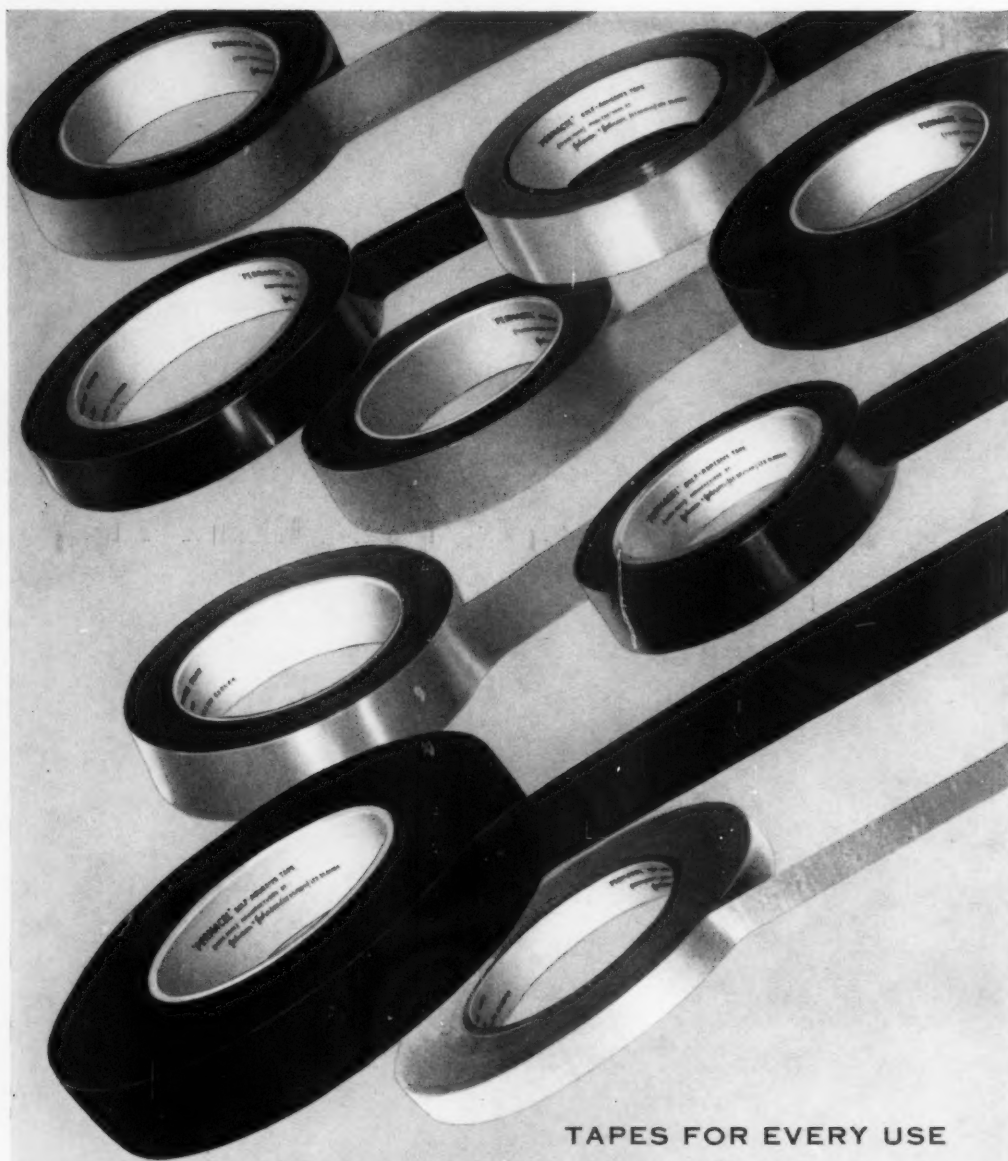
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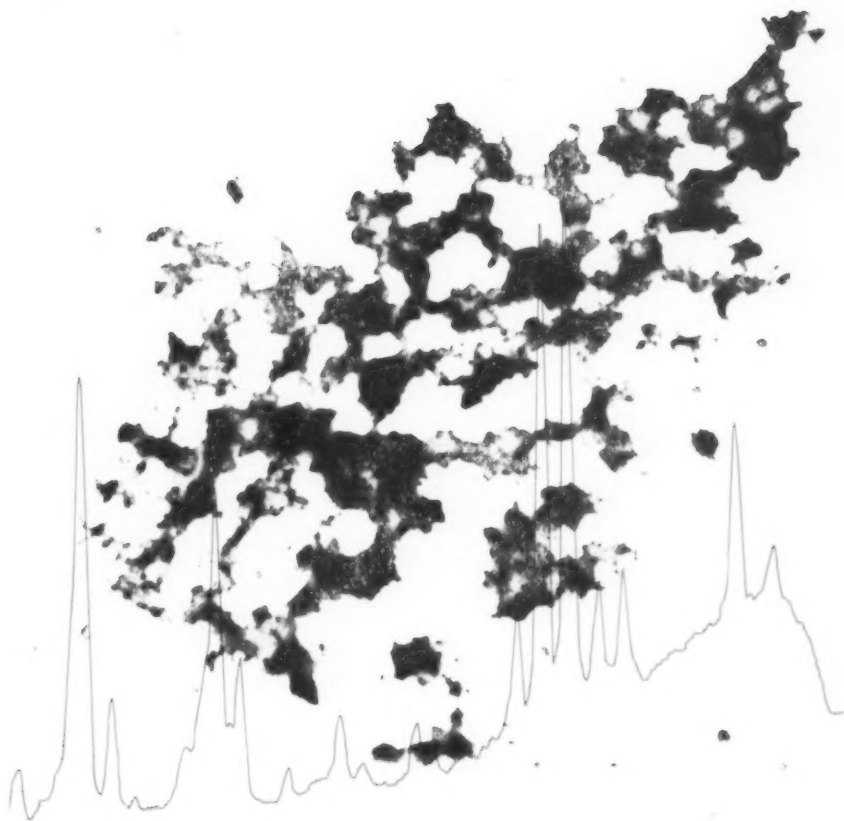
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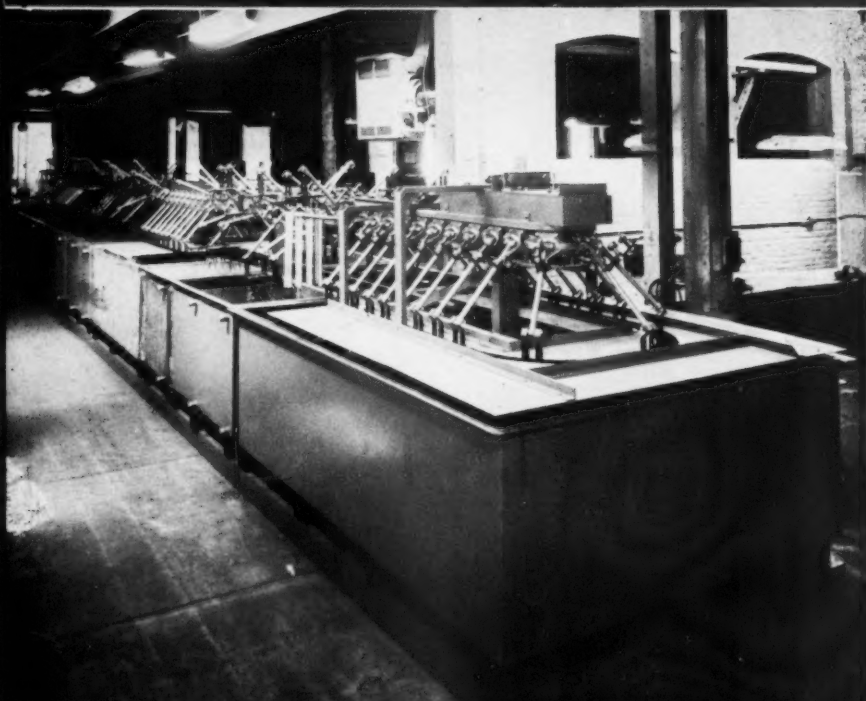
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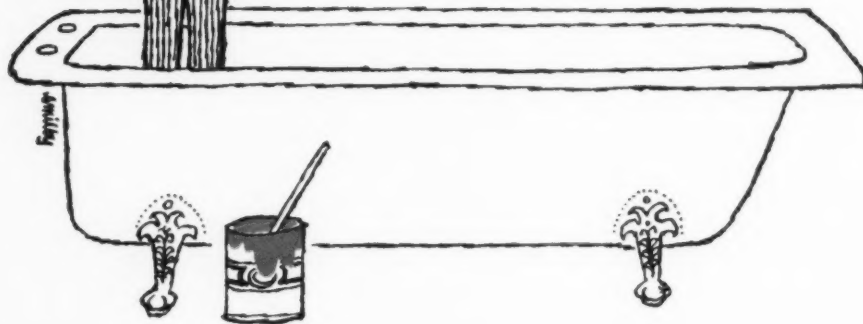
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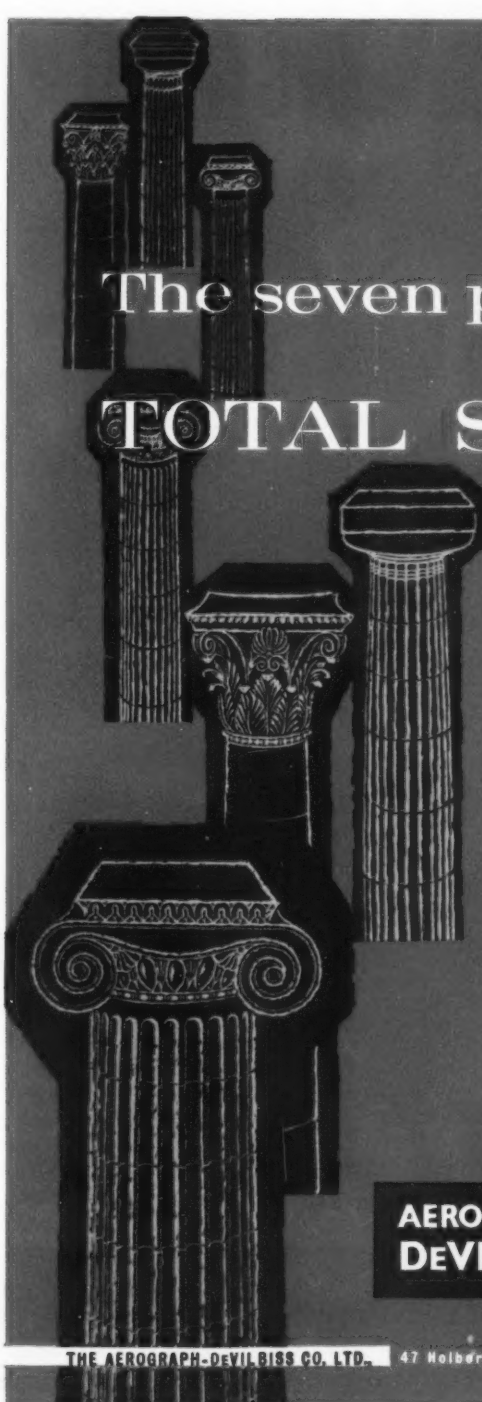
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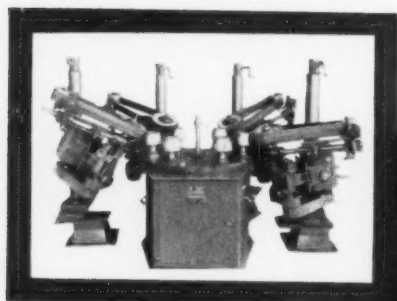
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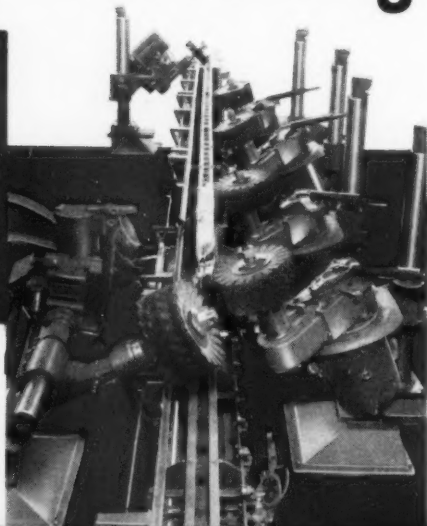
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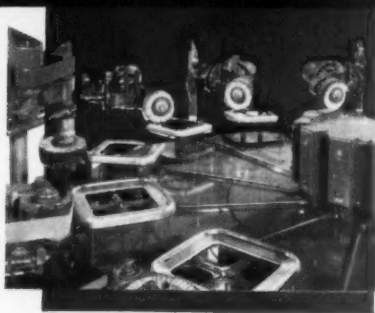
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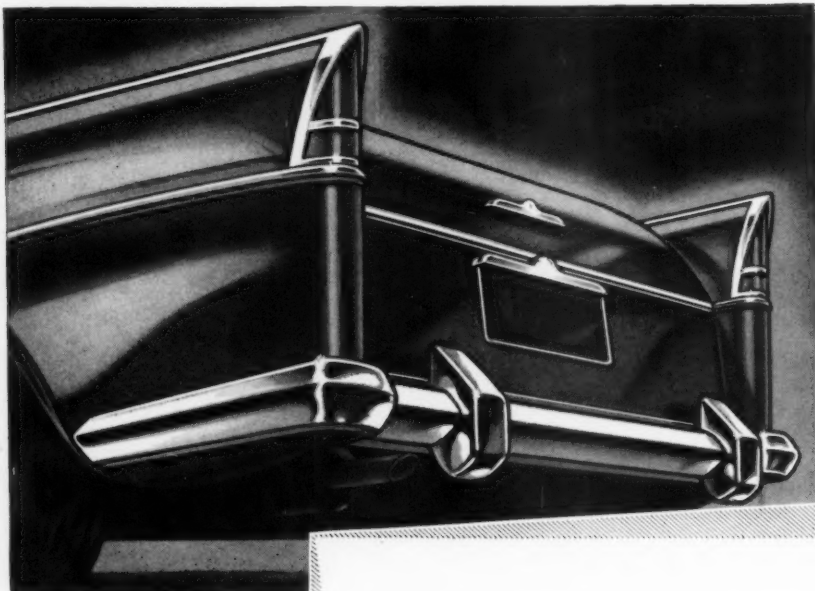
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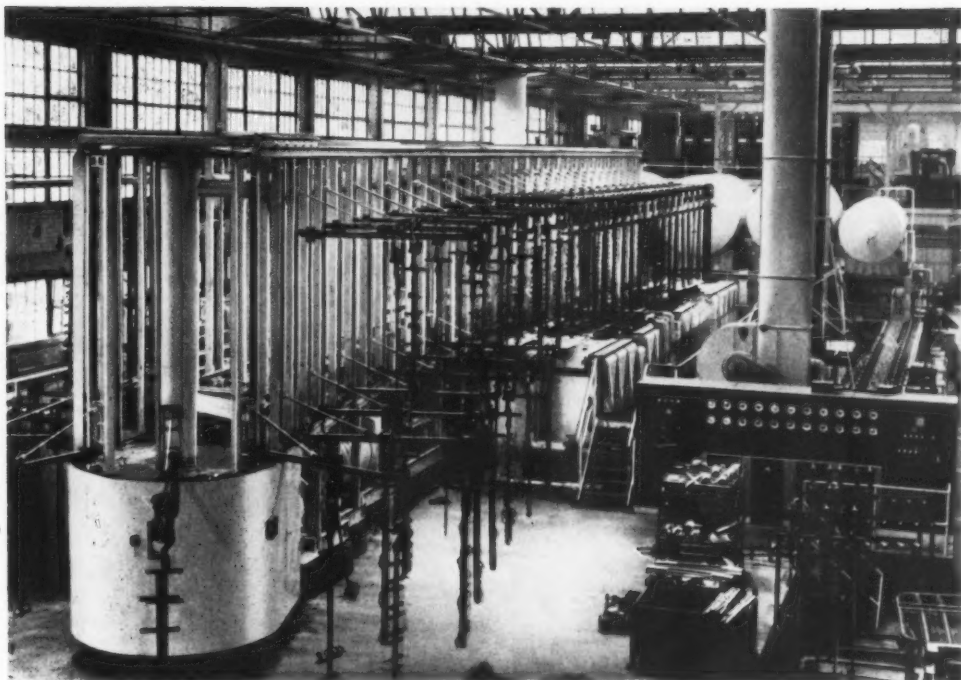
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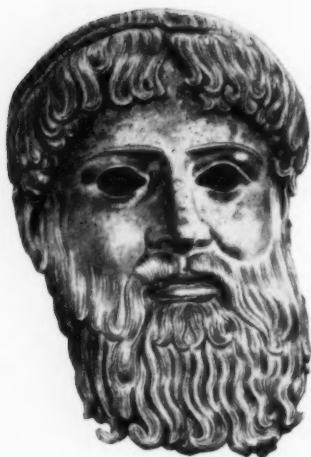


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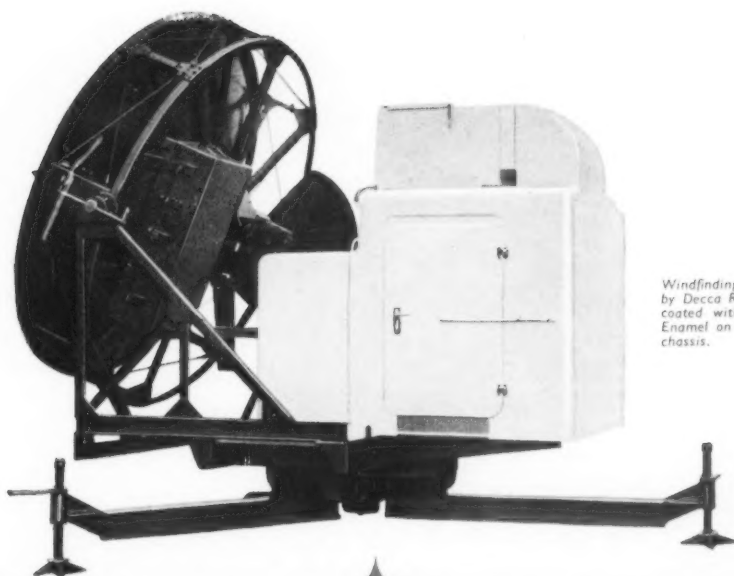
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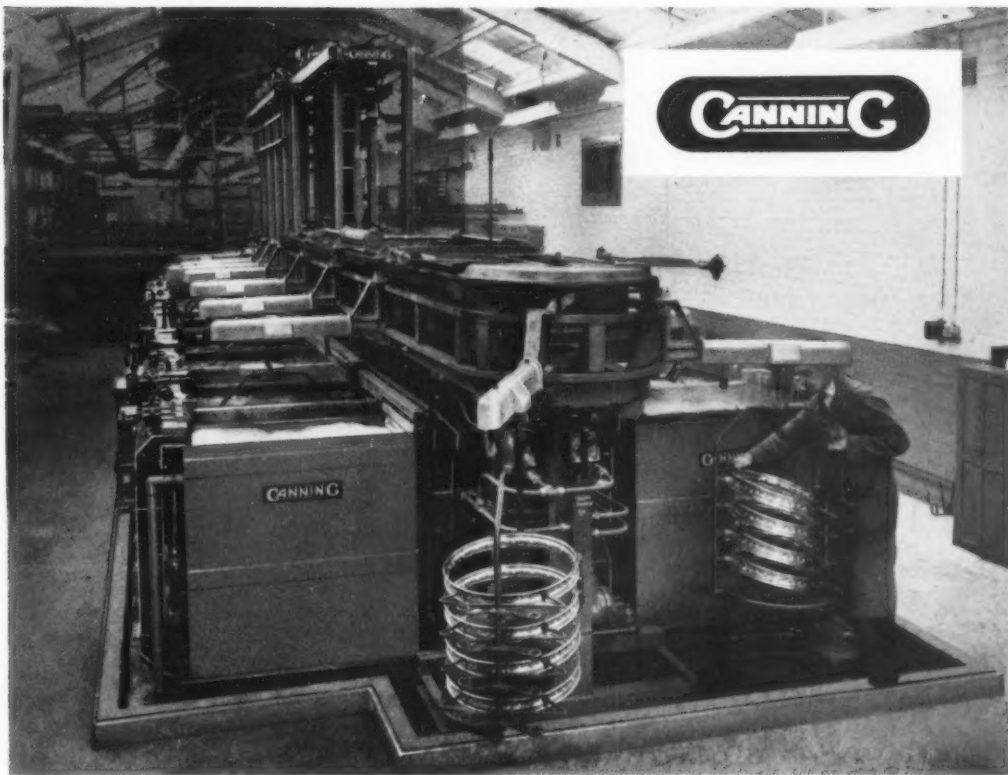
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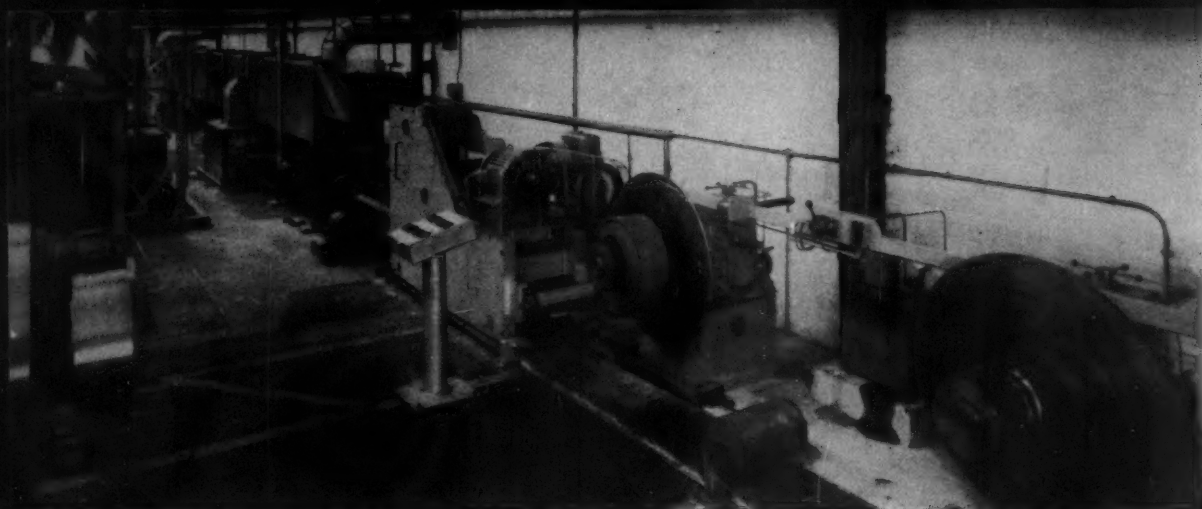


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CUMBRIA HOUSE · GOLDTHORN HILL · WOLVERHAMPTON

metal finishing Journal

March, 1961



Vol. 7, No. 75 (New Series)

Editor : EDWARD LLOYD, A.I.M., A.C.T.(Birm.)

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Production Manager : R. J. LOVELL

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THIS JOURNAL IS DEVOTED TO THE SCIENCE AND TECHNOLOGY OF PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, ANODIZING, METAL SPRAYING & ALL METAL FINISHING PROCESSES. THE EDITOR IS PREPARED TO CONSIDER FOR PUBLICATION ANY ARTICLE COMING WITHIN THE PURVIEW OF "METAL FINISHING JOURNAL" AND ALL SUCH ARTICLES ACCEPTED WILL BE PAID FOR AT THE USUAL RATES.

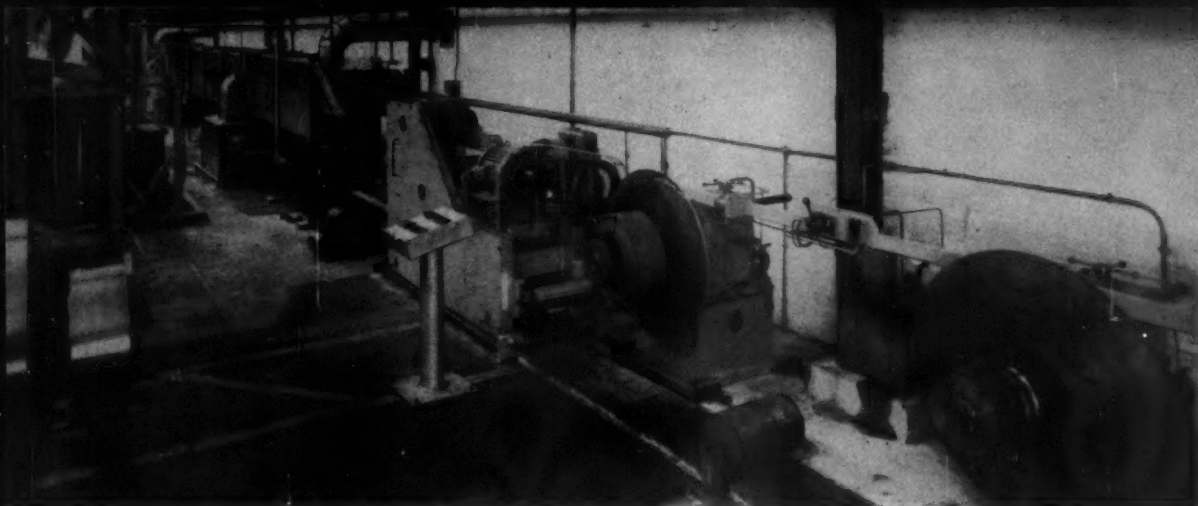
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CONTINUOUS STRIP PRE-TREATMENT AND FINISHING PLANT



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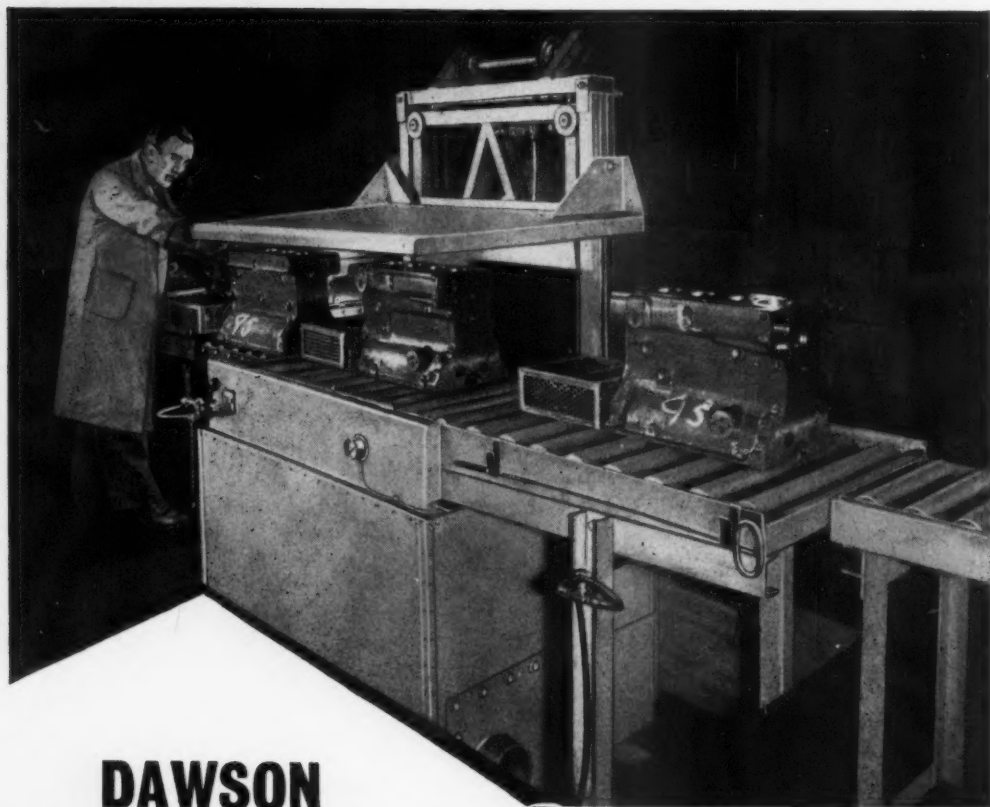
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BOOTS AND BOOT LIDS

SUCH is the nature of the climate of this Island and also because Mr. McAdam saw fit to utilize sharp edged flints in the construction of highways, it has been necessary ever since we took our first tottering steps while clutching at our Mother's skirts, to encase our feet in some form of protective enclosure. These shoes, which we have worn, have consisted of a tough and sturdy sole to resist the abrasive attacks of the highways and city pavements, and a weather resistant upper to repel the rain and protect our sensitive extremities from undue chill.

It would also have appeared not unreasonable to suppose that an additional attribute of a shoe should be that it should encase the foot snugly, giving support where needed and exercising no undue pressure which might distort the shape of the limb.

These then are the criteria and in themselves sufficient, but in this complex society of which we are a part it has become manifest that further considerations must be introduced. Some anonymous and faceless dictator has decreed that from time to time shoes should conform to a design which bears no relation to any of the basic criteria of footwear as set out above and, such are the vagaries of human conduct that these dictates are blindly obeyed and for a spell the only shoes manufactured, marketed and worn are those whose style is in accordance with this apparently binding decree.

It is not always easy in such cases to differentiate effectively between cause and effect, that is to say whether manufacturers produce the goods to meet an overwhelming public demand or whether the public purchases the goods available because it is given the same choice as that traditionally offered by the legendary Hobson.

What is true of winkle-pickers can also apply to no little extent in the field of finishing. There are many objects on the market today whose primary purpose is a purely functional one and hence it may be fairly assumed that the finish thereon should be of an equally functional nature. It would not be unreasonable to consider a motor car as falling within this category. A motor car is a means of transportation whose sole purpose is to convey people and their property from one geographical location to another. As it is largely made of metal, and for most of its working life is exposed to the inclemencies of the weather, some form of protective coating must be applied to its surfaces to prevent corrosion from taking its toll. Accordingly there has emerged an agglomeration of paint and electroplate of a quality that would do justice to a jewelled casket.

The quality of the inspection of a painted car body is of the very highest order, and re-processing is called for in the case of defects that the average car owner would be hard put to discern even under the closest scrutiny. The proportion of the cost of a car which must be represented by the provision of this superlative finish must be considerable, and yet there is no manufacturer who would dare to lower his standards because of the suppositional requirements of the purchasing public.

While we will continue to oppose in every way possible on this page any trend towards shoddy or inadequate finishing, we feel that there may be some danger of considerations of glamour outrunning the reasonable requirements of appearance and protection.

Talking Points

by "PLATELAYER"

TOPICAL COMMENT
FROM THE MAIN
LINES AND SIDE
LINES OF METAL
FINISHING

OPTIMISTS VINDICATED

INDUSTRIAL prognostication has always been a hazardous occupation—especially for the forecasters of continuous shortages, who have been proved wrong so often. Pessimistic estimates of the world's coal and oil resources, for example, have been responsible for the vast (and, many think, premature) expenditure on atomic energy. It is no wonder, therefore, that extrapolations are now more and more suspect.

The likelihood of future shortages of either steel or automobiles is rendered even more remote by the expansion plans of these industries, in the face of what appears to be considerable surplus capacity. The British Iron and Steel Federation, for example, predicts that the steel-making plants in the United Kingdom will be capable of producing 3.4 m. tons per annum in 1965, as against 2.6 m. tons last year. This is in spite of the fact that demand is not expected to exceed 3.0 m. tons by that time, the excess capacity presumably being available to cope with peak demands.

In the case of motor cars, the new planned capacity will enable 2.4 m. vehicles per annum to be produced by 1965, as against 1.3 m. at the moment. Car manufacturers have very much in mind the fact that, in this country, there is only one motor-car for every nine inhabitants, as against one for every three in the United States.

A RETROGRESSIVE INDUSTRY?

THE steel industry in the U.S.A. is still running at about 70 per cent of capacity and, in fact, a recent investment survey described steel as a "retrogressive industry." The reasons for this are several. In the first place there is the competition that steel is meeting from alternative materials, notably aluminium and plastics. Second, and perhaps even more important, is the fact that less and less steel is being made to do more and more work. This is being achieved by improvements in design and fabrication which result in much more efficient use of the material.

One result of lighter steel structures is that there is less margin for the effects of corrosion, and, therefore, greater attention must be paid to finishing procedures. It may well be that improvements in plating and painting, and the use of pre-finished steel sheet and strip have made it possible for lighter sections to be used. At the same time, the improved durability of finishes helps to make steel structures last longer and so contributes to a reduced demand for the metal.

The implications of these developments merit very careful consideration on the part of the steel industry in this country; they are no doubt getting it.

CONCRETE EXAMPLES

CONCRETE lighting standards are seldom things of beauty, and this applies even to the best designed ones. Hardly a week passes without horrified protests being made on the suggestion that standards might be installed in some picturesque locality or other. But what often makes them infinitely worse looking is the fact that a great many have various traffic and speed restriction signs clamped onto them, and that such clamps are quite inadequately protected against corrosion. The result is that red stains run down the concrete columns, permanently disfiguring them. The clamps also rust through and the signs then fall off, or remain perched at eccentric angles.

It would be interesting to know whether the makers of these signs are really ignorant of the conditions the fixing clamps have to withstand, or whether the authorities are so cheeseparing that they will not pay for a properly finished job. At least one system of attachment using stainless-steel bands and buckles is available.

TOO MANY TONGUES

WITH the growth of international technical literature, the problem of resolving linguistic barriers becomes ever greater. Technical dictionaries of all kinds multiply in numbers, and there are even rudimentary electronic translating machines.

One of the latest additions is a new nine-language International Electrotechnical Dictionary, of which the first volume has been published in Poland. The method of use is to look up the required term in one's mother tongue to determine its index number, each term being listed under its appropriate number in Polish, German, English, Spanish, French, Italian, Dutch, Russian and Swedish.

Excellent — but how cumbersome !

NOBODY TOLD THEM !

THE closing down date for Norman Cycle Works, Ashford, Kent, set at March 31 by Tube-Investment-Raleigh group, is now 'fluid' after trades' union representatives had shown figures to the directors to prove the factory had ample orders and was an efficient concern."

—Evening News.

A Survey of RECENT DEVELOPMENTS IN CHROMIUM PLATING

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(One of a series of lectures, presented under the title of "Recent Developments in Electrolytic Metal Finishing" at the Borough Polytechnic, London, and published by permission of the Principal).

CHROMIUM coatings are used for two purposes, (1) as a decorative coating on enumerable articles from motor-car components and trim to household equipment and fancy articles, and (2) as a wear-resistant coating for engineering purposes. For decorative use the chromium is only between 10 and 50 millionths of an inch thick while for engineering purposes it is usually between 0.0005 in. and 0.010 in. thick according to the service required. Decorative coatings are plated over an undercoat of some other metal, usually nickel, which acts as the main protective coating to prevent corrosion of the basis metal. The chromium is usually only considered as a "decorative overlay" which gives the nickel tarnish resistance, although, as will be shown later, the chromium can play an important part in the corrosion resistance too. Occasionally decorative chromium is plated direct over copper basis metals. Apart from nickel, the only other useful undercoat for decorative chromium is tin-bronze with about 10 to 12 per cent tin.

Plating Solutions

The same types of solutions are used for both decorative and engineering purposes. The most common is a straight chromic-acid solution containing from 250 to 500 gm. per l. (i.e. from 2.5 to 5 lb. per gallon or 250 to 500 lb. per 100 gallons) of chromic acid plus sulphuric acid to the extent of 1 per cent. of the chromic acid concentration. The relationship between the chromic and the sulphuric acid concentrations is often expressed as a ratio; and the solution is said to have an "acid ratio" or a "sulphate ratio" of 100:1. The sulphuric acid is known as the "catalyst," since no chromium would be deposited from a chromic acid solution unless there was some sulphuric acid, sulphate or other comparable catalyst radical present in the solution.

The other solution in common use employs a mixture of sulphuric and fluosilicic acid (or sulphate and fluosilicate) as the catalyst. A typical formula is⁽¹⁾ :—

Chromic acid (CrO_3)	250 gm. per l.
Sulphuric acid (H_2SO_4)	0.6 per. cent
Fluosilicic acid (H_2SiF_6)	1.0 per. cent

This formula suggests that 10 parts of fluosilicic acid are equivalent to 4 parts of sulphuric as regards the "catalyst action"; but there is probably some latitude in the amount of fluosilicic acid which can be used since other formulae show the usual 100:1 sulphate ratio plus fluosilicate additions.

Straight chromic/sulphuric acid solutions were the first to be used for commercial chromium plating and there is a very wide background of knowledge about their behaviour, about how changes in the total concentration, in the acid ratio, in the plating temperature and how the current density and so on will affect the plating efficiency and the properties of the deposits. It is relatively easy to analyze the solutions for the chromic and sulphuric acid contents and to make any corrections needed. Most people use sulphuric acid as the catalyst, but some proprietary solutions use chromium sulphate or other soluble sulphates in order to market ready-mixed dry salts for making up solutions.

The background to solutions with mixed silico-fluoride/sulphate catalysts is not quite so widely known, but in general their behaviour would seem to be fairly similar to that of straight chromic/sulphuric acid solutions. The big difference between them is that for any particular temperature and current density the silicofluoride/sulphate solutions give from 25 to 50 per cent greater cathode efficiency than plain chromic acid/sulphate solutions. One difficulty is that they are not quite so simple to analyze for sulphate and silicofluoride content to enable corrections to be made in catalyst content when required. However, there are proprietary "self-regulating" solutions

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available which overcome the problem of analytical control. It is these solutions, the S.R.H.S. (Self-Regulating/High Speed) solutions, which are the main rivals to straight chromic/sulphuric acid solutions in this country and in America. A typical formula was given in the patent specification⁽²⁾:

Chromic acid	92.5 per cent
Strontium sulphate	2.0 per cent.
Potassium silicofluoride	5.5 per cent

This is dissolved in water to give solutions with chromic acid concentrations between 200 and 500 gm. per l. It should not be assumed that the true catalyst concentration is the same as the sulphate and silicofluoride content in the formula, because the whole point about these self-regulating solutions is that a proportion of the catalysts remains undissolved on the bottom of the plating tank. The real catalyst concentration is therefore the limiting solubility of these constituents in the chromic acid solution. It can never exceed this amount, but, if there should be any tendency for it to fall below this value, then it will be replaced by dissolution of some of the reservoir of solid catalyst lying at the bottom of the solution, thus providing self-regulation of the catalyst concentration.

Plating Conditions for Decorative Plating

Solutions with concentrations from 250 to 500 gm. per l. chromic acid are used with plating temperatures from 100° to 130°F. (38° to 55°C.) and current densities from about 100 to 300 amp. per sq. ft. For any particular concentration of solution there is a definite current-density range over which the deposits are bright. At current densities below this range the deposits have a dull milky appearance and the cathode efficiency is very low. (At still lower current densities the efficiency is nil, i.e. only hydrogen is deposited). As the current density increases the efficiency increases steadily, but above a certain current density, the top limit of the bright range, the deposit becomes first dull and later rough and burnt, although the efficiency still continues to rise. If the plating temperature is increased, the range of behaviour shifts to a higher range of current densities, whereas if the chromic acid concentration is increased the behaviour shifts downwards to a lower range of current densities. In the latter case, the cathode efficiencies over the whole range are reduced.

In the early days solutions containing 250 gm. per l. chromic acid were used for decorative plating. The tendency, since then, has been to use more concentrated solutions, mostly with 350 to 500 gm. per l. chromic acid, since the sulphate ratio is then slightly less critical. Also, the better conductivity reduces the voltage across the plating bath and this, together with the lower current

densities used with the more concentrated solutions, allows chromium plating to be carried out with smaller capacity rectifiers or dynamos than would be possible with the weaker solutions. However the lower plating currents and lower efficiencies mean that much longer plating times are required to get any particular thickness of chromium. This general behaviour would seem to apply equally well to both chromic/sulphuric acid solutions and to mixed catalyst solutions.

The only other essential in chromic acid plating solutions, as well as the catalyst, is that there should be a small amount of trivalent chromium present. As some trivalent chromium is formed through reduction of the chromic acid at the cathode surfaces, there is no need to make any actual addition to the solutions—although small additions of reducing agents, such as tartaric acid, sugar or methyl alcohol,* are sometimes made to new solutions to provide an initial small amount quickly. Once the baths are in use, the trivalent chromium content tends to build up to some definite concentration due to the equilibrium between the amount formed by reduction at the cathode and the amount oxidized back to chromic acid at the anodes. The actual "equilibrium amount" depends largely on the current densities employed in plating and the anode areas. In some cases there is a tendency for the trivalent chromium to build up excessively and after a certain concentration (about 15 gm. per l.) it can become harmful and will reduce the bright plating range. Excessive iron which sometimes tends to build up in old solutions can have a similar harmful effect.

Porosity and Cracking of Chromium

It has been known for a long time that, once the thickness of chromium deposits exceeds quite a low figure, the chromium starts to crack. Early work by Blum and his colleagues⁽³⁾ in the U.S.A., who used porosity testing techniques, showed that the optimum chromium thickness was about 0.00002 in. Below this thickness the chromium tended to be very porous, while above it the chromium tended to crack. In the Standard Specification for nickel/chromium plating, B.S. 1224, it is specified that the chromium should be at least 0.00001 in. at every point on the plated surface. Since the distribution of chromium coatings is far from uniform, even on quite simple shapes, it means that the average thickness will be about 0.00002 in., that is the optimum recommended by Blum. Actually Blum and his colleagues also noted that the "optimum thickness range" or the range over

* In experimental work 1 ml. per l. methyl alcohol was added and gave an initial trivalent chromium content of 2.9 gm. per l., but after working the solution the concentration tended to level out at 1.7 gm. per l.

which the porosity was practically eliminated but the cracking had not yet started, could be extended quite appreciably by raising the plating temperature and by using an acid ratio of 150:1 instead of the usual 100:1. But the significance of this was not appreciated till quite recently.

Improved Decorative Chromium Overlays

In the last few years much research and development has been carried out to improve the quality of decorative chromium overlays in order to improve the protective value of nickel/chromium coatings. The need for such improvement had become obvious and there is little doubt that present Standards are really not satisfactory enough for plating that is to be used outdoors on motor-cars etc. This is particularly true for plated zinc-alloy die-castings. Until two or three years ago little was done to try and improve the corrosion resistance of chromium overlays, because the general belief was that the troubles experienced in service were due to the porosity of the nickel coatings and that the chromium layer itself played very little part. However, a few years ago it was shown by Wesley and Knapp⁽⁴⁾ in America and by Edwards⁽⁵⁾ in this country that the break-down of nickel/chromium plating on exposure was mostly due to direct corrosion of the nickel itself by corrosive elements in the atmosphere, particularly the sulphur dioxide present in industrial atmospheres, and that any effects from porosity in the nickel coating were of minor importance. This background of the real mechanism of corrosion makes it fairly obvious that there are two ways of improving the corrosion resistance. Firstly the use of thicker nickel coatings can prolong the life before corrosion can penetrate through to the basis metal. Alternatively duplex nickel can be used, as it also slows down the rate of penetration to the basis metal. Secondly, it should be possible to reduce the corrosion considerably by improving the chromium overlays, because corrosion of the nickel can only start where there are discontinuities in the chromium overlay, for example at cracks or pores in the chromium.

Following this last reasoning, interest was revived in the use of higher temperatures and higher acid ratios for chromium plating. It has now been clearly demonstrated that by this means it is possible to deposit chromium coatings where the minimum at any point will be at least 0.000025 or 0.00003 in. before any troubles are experienced from cracking. This might still seem a very thin chromium coating, but it is two or three times the present specification, and it is surprising what a large difference it makes to the corrosion resistance when used in conjunction with the standard 0.0010 in. or 0.0012 in. of nickel. An example of the

improvement obtained was given in a B.N.F. publication.⁽⁶⁾ Exposure tests on plated zinc-alloy diecastings showed that increasing the chromium from 0.00001 in. to 0.00002 in. reduced the "service blistering" on exposure by about 50 per cent., and increasing it to 0.00003 in. almost halved the blistering again. This applied with undercoats of 0.0006 in., 0.0010 in. and 0.0014 in. of nickel, and although each increase in nickel thickness also reduced the service blistering, an additional 0.00001 in. chromium had a bigger effect in each case than each 0.0004 in. nickel.

The most important factor for getting improved chromium is the use of higher plating temperatures, while an increase in acid ratio from 100:1 to 150:1 is a second factor which helps, but to a more limited extent. In general the higher the plating temperature the less is the tendency for the chromium to crack. Or, in other words, the higher the plating temperature the lower is the internal stress in the chromium and so the greater the thickness that can be deposited before the chromium starts to crack. In fact, if the plating temperature is increased to 75°C. or more the stress is so low that the chromium will not crack at all however thick; but unfortunately it is no longer bright.

In practice when higher temperatures are used it is of course necessary to use correspondingly high current densities, firstly, to keep the chromium bright, secondly, to obtain satisfactory covering and throwing into recessed areas and thirdly, to maintain a satisfactory plating efficiency. The best plating conditions are probably; a 250 gm. per l. chromic acid solution, a 150:1 acid ratio, a plating temperature of about 53°C. (128°F.) and current densities of about 250 to 350 amp. per sq. ft. Under these conditions the required minimum of 0.000025 in. to 0.00003 in. of chromium can be plated in the conventional plating times of 4 to 8 minutes. However, the use of this high plating temperature with its high current densities involves the use of rather large rectifiers (or dynamos) as regards both amperage and voltage. If one wishes to avoid this, then it is possible to use somewhat lower temperatures and current densities by employing more concentrated plating solutions. The lowest practical temperature to get satisfactory results is probably about 42°C. and should be used with a 500 gm. per l. chromic acid solution and current densities between about 130 and 180 amp. per sq. ft. Any intermediate temperature between 42° and 53°C. can be used by employing an appropriate intermediate concentration and current density. Some details of this are given in the B.N.F. Report.⁽⁶⁾ But of course the plating time will be longer, not only because of the lower current densities used but also because the efficiencies are lower in the more concentrated solutions.

In practice it may still be a little difficult to get the required minimum of about 0.00003 in. in recessed areas of some shapes, i.e. sufficient thickness to ensure virtual freedom from porosity, without the chromium becoming so thick at high current density areas that it will still crack despite the improved plating conditions. Careful jiggling arrangements can do much to prevent excessive chromium build-up at high points and the use of auxiliary anodes, as often used in America in decorative plating, can also help considerably. But slight cracking of the chromium at high current density areas is not particularly harmful in practice, since the nickel undercoat will also be thickest in these areas and will prevent any rapid corrosion through to the basis metal.

Mixed sulphate/fluosilicate catalyst solutions show no real advantage over plain chromic acid/sulphate for plating this "bright crack-free chromium" as it is sometimes called, although H.T.H.R. (High Temperature-High Ratio) would seem a much better description. But, if the advantages of the rather higher efficiencies and self-regulating properties of S.R.H.S. solutions are desired, then there is a proprietary modification of the S.R.H.S. solution available. Presumably it has a low dissolved catalyst concentration, comparable with a 150:1 acid ratio, but the solution has of course still to be used at fairly high temperatures and current densities to achieve the desired results. Incidentally, there are also proprietary H.T.H.R. solutions of the straight chromic acid/sulphate type.

Further Improvement of Chromium Overlays

Although the improvement gained by using H.T.H.R. chromium can make a big improvement in the durability of nickel/chromium plating, it is not possible to use much thicker coatings than those already discussed in order to get still better durability, because cracking would then become a serious defect. This applies with bright chromium; but if one were satisfied with dull coatings, then there would be many ways of getting really thick chromium of excellent protective value, by using either:

- (1) straight chromic acid/sulphate solutions at 70°C. with the necessary high current densities,
- (2) a mixed sulphuric/selenic acid catalyst solution (Br. Pat. 798,590) which only requires fairly conventional plating temperatures and current densities.
- (3) a proprietary S.R.H.S. "crack-free" solution which is used with temperatures and current densities comparable with H.T.H.R. solutions.

Quite recently two new methods of achieving better durability without sacrificing the brightness of the final chromium have been proposed:—

Duplex or Dual Chromium

For this an initial layer of "crack-free" H.T.H.R. chromium is deposited over the nickel and then followed by a layer of micro-cracked chromium, i.e. a deposit which has a very close network of fine cracks. The theory is that on exposure, the corrosion will spread over the whole network of these cracks, which will give a much slower rate of penetration through to the underlying basis metal than would occur if the corrosion was concentrated at a few pores or isolated cracks. The first layer of chromium can either be deposited from a chromic/sulphuric acid H.T.H.R. solution or from a proprietary "bright crack-free" mixed catalyst solution. The latter is said to be specially advantageous as it covers well in recesses and low current density areas. The most important point would seem to be that the first layer should be free from any coarse crack pattern—slight porosity and slight blooming of the chromium will probably not matter. As regards the final micro-cracked chromium, so far, the only solution suggested for giving the satisfactory fine crack pattern is another modified S.R.H.S. solution, rather more dilute than the standard solution and used at a moderately low temperature. At first it was imagined that the cracks in the top layer of chromium would only penetrate down to the top surface of the initial chromium overlay, but it is now known that the cracks are propagated through the initial layer to produce the micro-crack pattern right through. The system is particularly interesting as theoretically there seems no limit to the chromium thickness that can be used for the final coating.

Sandwich Chromium

In this system an initial layer of nickel is deposited, then a layer of chromium, another layer of nickel and finally the usual overlay of chromium, which for preference should be of H.T.H.R. chromium. In order to plate the layer of nickel over the chromium it is of course necessary to use a highly acid nickel strike (Wood's nickel strike) in order to get satisfactory adhesion before depositing from the normal bright nickel bath. On exposure, the mechanism is that any corrosion starting at odd pores or cracks in the chromium overlay will only penetrate downwards through the first layer of nickel and then be stopped at the underlying chromium, although the corrosion may then tend to spread sideways to widen out the corrosion spots. To do this satisfactorily the chromium for the interlayer should be free from both cracks and pores; but it is probably not necessary for it to be bright, although it must be smooth enough to "take" bright nickel properly. Presumably it could be a reasonably thick layer if desired.

So far there is not much evidence of how well the two systems actually behave in service, although the duplex chromium system is being used in at least one quite large plant in the U.S.A., which sounds very hopeful. Sandwich chromium is probably not yet being used commercially, but laboratory plated samples have shown good corrosion resistance in exposure tests. It is interesting that both systems involve the use of H.T.H.R. chromium and so could not really have been developed before the behaviour of H.T.H.R. plating was properly understood. One point that should perhaps be mentioned here is that to control H.T.H.R. processes it is important to have good tests (1) for showing just what porosity and cracking is present in the chromium and (2) for measuring chromium thicknesses accurately. The SO_2 test provides an ideal test for indicating porosity or cracking in chromium and coulometric testing instruments are being developed for obtaining rapid and accurate measurement of chromium thicknesses. The American Kocour Tester is of this type and a rather similar instrument developed by the B.N.F. will be on the market very shortly.

Heavy or Hard Chromium Plating

The two terms are really synonymous because all chromium deposits from chromic acid type solutions are hard with Vickers hardness numbers between about 800 and 1,000. The only cases where one might consider that the chromium is not hard is when it is so thin that it wears through rapidly or is insufficiently thick to prevent it being pushed or dented into the underlying basis metal in normal service.

As mentioned earlier both chromic acid/sulphate solutions and mixed catalyst silicofluoride/sulphate solutions are used for heavy chromium. With the latter, both straight mixed catalyst baths and self-regulating (S.R.H.S.) solutions are used. The advantage of mixed catalyst solutions is their higher plating efficiency which can reduce the plating times by about 25 to 33 per cent which is of great value when the plating times are long as they must be to get thick coatings. In spite of this, straight chromic acid/sulphate solutions are still frequently used because of the simplicity of composition and analysis and because of the long background of experience associated with them. The conventional 100:1 acid ratio is quite satisfactory for heavy chromium and is probably actually the best ratio to use. One slight disadvantage of mixed catalyst solutions containing silicofluorides is that they attack steel at low current density areas where the current density is too low to deposit any chromium and such places must therefore always be stopped-off in these solutions.

With both types of solution it is usual to use the less concentrated solutions, ones with about 250 to 300 gm. per l. chromic acid, and to use fairly high temperatures and current densities. Temperatures are usually from 100° to 140°F. (43° to 60°C.) and there is a two-fold advantage in using the higher temperatures: (1) the deposits are smoother with less tendency for nodular growths at corners and edges, and (2) the high current densities which can be used, and in fact must be used, give much faster rates of plating. Actually the rate of plating is slightly more than doubled when the current density is doubled, because the efficiencies improve slightly as the current density is increased. At 110°F. one would use a current density of about 160 amp. per sq. ft. which deposits about 0.005 in. per hour; while at 140°F. one would use about 550 amp. per sq. ft. which would deposit nearly 0.002 in. per hour. Details of suitable current densities to use for various temperatures, together with the plating speeds achieved, are given in most text-books⁽⁷⁾ and also in the D.T.D. specification No. 916.

Plating on Steel and Cast-Iron

After preliminary degreasing and removal of any rust or oxides from the surface it is necessary to etch the steel or cast-iron in order to get satisfactory adhesion. The purpose of the etch is to remove any surface layers which have become weakened or distorted through prior machining, grinding or polishing operations, since distorted layers of this kind are appreciably weaker than the main bulk of the components and also weaker than the chromium deposited on them. The most popular etching solution is one similar to the plating solution, e.g. 250 gm. per l. chromic acid plus 2.5 gm. per l. sulphuric acid. It is used at temperatures of about 115 to 130°F. with current densities from about 150 to 500 amp. per sq. ft., the work being made anodic. Some alloy steels may require up to 10 or 15 minutes' etching, but mild steels need a much shorter time. It is normal to give the deepest etching when very thick coatings are going to be deposited and shorter etchings for thinner coatings, partly because the longer etches roughen the surface, but chiefly because maximum adhesion is usually required with really thick chromium.

It is preferable to carry out the etching in a separate tank, although in some cases the etching is done by merely reversing the current for a short while in the actual plating bath before starting to plate. With large awkward articles the latter procedure is necessary because of the difficulty of rapid transfer from one tank to another. The main disadvantage of etching in the plating tank is that quite appreciable amounts of trivalent chromium are formed and that some iron also

dissolves in the solution. Although chromium plating solutions can often tolerate up to about 15 gm. per l. of either trivalent chromium or iron, greater contamination than this can be detrimental to the quality of the deposits.

An alternative treatment is anodic etching in moderately strong sulphuric acid (S.G. about 50 to 55°Be) which must be kept below 70°F. A voltage of 6 volts is usually applied and current densities are of the order of 150 to 160 amp. per sq. ft., etching being continued until there is a copious evolution of gas (oxygen) from the steel. Parts must of course be rinsed thoroughly, but quickly, before being transferred to the chromium bath after this etch. Another proposed etch is 10 per cent oxalic acid used at 10 volts. In both cases, with high carbon steels, some smut is left on the surface which may require brushing off.

Heavy Chromium Plating on Aluminium

Although more and more aluminium components seem to be plated with heavy chromium, the plating industry seems to be very secretive about the techniques that are actually used to obtain satisfactory adherent coatings on aluminium. Decorative chromium is nearly always plated over nickel, using one of the well-known techniques, such as the zincate process or the Vogt process, to get satisfactory adhesion of the nickel to the aluminium, and then plating with decorative chromium in the normal way. Although it has sometimes been suggested that heavy chromium might be plated over a nickel undercoat too, in practice this never seems to be done.

Many methods have been suggested in textbooks⁽⁷⁾ and in various patent specifications. One suggested method uses sludge blasting of the aluminium with abrasives suspended in water, the sludge layer being left on the surface of the parts when they are transferred into the chromium bath and only falling away as the plating starts up. Other methods propose the use of acid etching solutions containing heavy metal salts, such as nickel or ferric chloride or manganese sulphate, which leave replacement deposits of these metals on the cleaned aluminium surface. Other suggestions are that it is quite practical to put the aluminium straight into chromic acid plating solutions after any normal cleaning method. A patent proposes having the chromium solution almost cold and using low current densities to prevent excessive gassing,⁽⁸⁾ while another proposal is to use the solution at 60°C. and increase the plating current density in steps; first from about 400 to 500 amp. per sq. ft. and finally to 600 amp. per sq. ft.⁽⁹⁾ Other patents propose etching treatments in solutions containing chromic acid, chromium chloride and hydrochloric acid⁽¹⁰⁾, or

alternate anodic and cathodic treatment in dilute hydrochloric acid at high current densities.⁽¹¹⁾

However the method that is probably used generally in this country is to prepare the aluminium and give it a zincate coating in exactly the same manner as that used for plating copper and nickel on aluminium and then to plate it direct in the chromium solution. The first published reference to this method seems to have been that by Corfe at the beginning of this year⁽¹²⁾ in a paper dealing with the whole subject of heavy chromium plating. After degreasing and alkaline cleaning in the normal way, the parts are given a 5 to 10 second dip in a mixture of 3 parts nitric acid : 1 part hydrofluoric acid. They are then rinsed and given an immersion coating of zinc from a zincate solution. It is best to use a double zincate treatment, as is normal practice for decorative plating on aluminium, i.e. to dissolve off the first zincate coating in nitric acid and then repeat the zincate treatment. Many platers seem to find that the proprietary zincate solution which contains a little copper cyanide gives a better result than a straight zincate solution. After the final zincate treatment the parts are rinsed and put into the chromium bath with the current flowing as they are immersed. Corfe states that the current should be rather higher than that which would normally be used for chromium plating steel components of the same size and shape. He also adds that with difficult shapes it is often useful to plate a few millionths of brass before going into the chromium bath.

Barrel Chromium Plating

At one time it was not considered possible to carry out chromium plating as a barrel plating operation. In recent times, however, there has been a gradual evolution of various special designs of barrels for chromium plating. The use of solutions with silicofluoride or other fluoride catalysts,⁽¹³⁾ which prevent the chromium from becoming dull whenever there is a break in the current, as must occur in barrel-plating, together with the specially designed barrels has now made the operation a perfectly satisfactory one for chromium plating small articles such as nuts and bolts. However, in nearly all cases the coatings produced are extremely thin, usually much under the standard 0.00001 in.

Spray Suppressing Agents

Up to a few years ago it was essential to have very efficient fume extraction systems on all chromium plating tanks. However a short time after the development of an efficient proprietary spray suppressing agent it was proved that it actually gave better protection against chromic acid spray and fumes getting into the surrounding

atmosphere than did most fume extraction systems. Consequently it is now legal to use chromium plating equipment without extraction systems, provided that satisfactory spray suppressing agents are used. It is now becoming accepted practice to use these spray suppressants in most decorative chromium plating tanks and exhaust equipment is no longer provided on many new chromium plating installations, with consequent savings in equipment costs and simplified designs. However spray suppressing agents should not be used in solutions for heavy chromium plating. The first agents were extremely satisfactory for decorative chromium plating solutions used at conventional plating temperatures (up to about 110°F.) and have been described by Ramsden.⁽¹⁴⁾ Recently a modified agent has been put on the market which is satisfactory for the higher temperatures employed in H.T.H.R. chromium plating. These agents are sulphonated organic compounds in which the hydrogen atoms have been replaced by fluorine atoms to provide stability against oxidation.⁽¹⁵⁾ Naturally such compounds must be fairly expensive, but as well as suppressing spray they provide other functions which counterbalance their cost: (1) there is no loss of chromic acid into an exhaust duct system, and (2) they lower the surface tension of the chromium plating solution and so provide better "drainage" from the plated articles and consequently prevent excessive carry-over of chromic acid to subsequent rinse tanks.

Chromium Alloy Plating

Although there is no indication of chromium alloy plating being used commercially, there seems to have been some progress with research on this subject in recent years. Theoretically there would seem to be two possible ways of depositing chromium alloys: (1) by making additions to chromic acid plating solutions, and (2) by using trivalent chromium solutions (e.g. chromium sulphate) with additions of other metallic salts.

There is little real evidence that it is possible to deposit alloys by adding salts of iron or nickel, to chromic acid solutions, but on the other hand there seems no reason why it should not be possible to co-deposit small amounts of metals such as molybdenum, tungsten, rhenium etc. by adding molybdates, tungstates, perhenates to chromic acid plating solutions. In fact there are definite claims for deposition of alloys with about 1 to 2 per cent molybdenum in this way.⁽¹⁶⁾ Whether any of these dilute alloys will have useful properties or improve the character of chromium coatings is something which is not yet known, although Shome did claim that the 1.5 per cent molybdenum alloy was more wear resistant.

Co-deposition with chromium from trivalent chromium solution has however made rather

more progress. The first step was the improvement of straight chromium sulphate or chrome alum plating solutions by adding first urea and later urea and formamide which⁽¹⁷⁾ gives ductile, almost bright, chromium deposits:—

Chromium sulphate	305 gm. per l.
Ammonium sulphate	200 gm. per l.
Urea	400 gm. per l.
Formamide	10 ml. per l.

Still brighter deposits were obtained by adding a little ferrous ammonium sulphate. Later, alloy solutions were developed by the Batelle Institute in the U.S.A.⁽¹⁸⁾, a typical solution being:—

Chromium ammonium sulphate (chrome alum)	300 gm. per l.
Ammonium sulphate	150 gm. per l.
Ferrous ammonium sulphate	5 gm. per l.
Methyl pyridinium chloride (brightener)	0.5 gm. per l.

This bath was worked at a pH of 1.4 to 2.5, at 110 to 130°F. with current densities of about 60 amp. per sq. ft. with Cr/Fe alloy anodes. The solution which is said to have levelling properties, deposits an 85 per cent Cr/15 per cent Fe alloy. Nickel or cobalt sulphates may be used to replace the whole or part of the ferrous ammonium sulphate and other brighteners, including urea (0.1 to 180 gm. per l.) or formamide (0.1 to 10 gm. per l.) may be used. The deposits are said to be fully bright and not to lose their hardness on annealing until the temperature reaches 1,000°F. However the deposits show the same type of crack patterns as ordinary chromium deposited from chromic acid solutions and nothing seems to have been said about the corrosion resistance of the chromium or the chromium alloys deposited from them, nor is the deposition efficiency anywhere near the 100 per cent cathode efficiency that one had hoped might be possible when the problem of depositing chromium from trivalent solutions had been solved. At best the efficiency seems to be about 30 per cent (calculated as trivalent chromium.).

References

- (1) Wahl u Gebauer, *Metalloberflaeche*, 1948 (2).
- (2) British Patent 697,786.
- (3) Blum, Brenner and Barrows, *J. National Bureau of Standards (U.S.A.)*, 1931, 697.
- (4) Wesley and Knapp, *Tr. Inst. Met. Finishing*, 1954, 31, 267-284.
- (5) J. Edwards (British Non-Ferrous Metals Research Association), *Product Finishing*, 1958, 11, (3), 58-66.
- (6) "Better Plating on Die Castings," Development Report, published by the British Non-Ferrous Metals Research Association, London, January, 1960.
- (7) e.g. "Chromium Plating" by Morriset, Oswald, Draper and Pinner, Robert Draper Ltd., Teddington, Middlesex.
- (8) U.S. Patent 2,836,550.
- (9) *Metalloberflaeche*, 1959, March.
- (10) U.S. Patent 2,847,371.
- (11) U.S. Patent 2,888,387.
- (12) I. Corfe, *Electroplating*, 1960, February.
- (13) H. Silman, *Trans. Inst. Met. Finishing*, 1955, 32, 43.
- (14) Ramsden, *Electroplating*, 1957, May.
- (15) U.S. Patent 2,846,380.
- (16) Shome, *J. Indian Chem. Soc.*, 34, 399.
- (17) Zell, U.S. Patent, 2,801,214.
- (18) U.S. Patent 2,822,326.



A Quarterly Survey of some of the Features
in Finishing Literature from Abroad
by SCRUTATOR

FOR several years now, depending on which side of the fence you are, aluminium trim has been considered as either a serious competitor to chromium-plated motor-car trim or as an interesting development of limited application. Much has been said about the alleged deficiencies of nickel/chromium-plated parts on motor cars and although duplex nickel and duplex chromium have been introduced to improve quality, with particular reference to corrosion resistance, the battle between 'chrome' and aluminium is still being waged. It came as a considerable surprise therefore to find that the reason for carrying out some recently published work on the atmospheric corrosion resistance of nickel/chromium-plated aluminium sheet⁽¹⁾ was that a bright chromium finish on aluminium is of interest in that it enables aluminium to compete with the 'chrome' appearance produced on other metals, particularly in the automobile and appliance fields. Is this an admission that after all the public really prefer the appearance of chromium plate to that of polished and anodised aluminium? Perhaps with our genius for compromise we may well have aluminium trim — only chromium plated!

In the above tests, bright chromium plated (Cu/Ni/Cr) 3S aluminium-alloy panels were exposed out of doors for up to 2 years in semi-rural and severe industrial atmospheres. The pre-plating procedures included the zincate, Vogt and phosphoric-acid anodizing techniques and the latter behaved particularly well with reference to freedom from blistering or flaking providing a minimum thickness of 1 mil. of nickel was employed. Panels processed by the zincate and Vogt techniques using less than 1.5 mil. of nickel failed within 1 year due to severe blistering. It is concluded that for severely corrosive industrial atmospheric exposure conditions a minimum of 1.5 mil. of nickel is required.

Reverting to the more usual treatments for finishing aluminium, namely anodizing, Botosan⁽²⁾ has given some very interesting details of techniques for decorating anodized work. He points out that very few anodizers attempt to go beyond the straightforward dyeing of anodized surfaces and he makes practical recommendations regarding multi-colour dyeing, colouring and silk-screen printing. Similarly, Jogarao, Indira and Shenoi⁽³⁾

have published details, again essentially of a practical nature, regarding photographic reproduction on anodized aluminium. This has, of course, been practised for some time but the authors discuss various techniques for printing permanent designs by photographic reproduction methods on 99.5 per cent purity 2S aluminium alloy. They recommend that for the 'blue-print,' gelatine emulsion and silver halide processes, sulphuric-acid anodizing should be employed and chromic acid for sepia tan.

Coating Processes

Almost without exception wherever large fabricated sheet-steel components, such as motorcars, washing machines, refrigerators, etc., have to be prepared for painting, they are first of all wetted using aqueous solutions for cleaning and phosphating and then dried again before painting. It has often been suggested that one way of eliminating drying before painting — an essential with aqueous pretreatment processes — would be to use a water-based paint. Many people, however, believe that the ultimate is to do away completely with the use of water and carry out cleaning, phosphating and painting without 'wetting' the metal. This is now being done in America on steel parts for the Chevrolet Corvair Engine. This technique which is claimed to be as new as the compact car itself⁽⁴⁾ uses trichlorethylene instead of water as the pretreatment and painting medium. The parts to be treated are suspended from an overhead conveyor travelling at 5 ft. per minute and the components are degreased, anhydrous phosphated and dip-coated in a trichlorethylene dip paint in an automatic three stage machine. Stage 1 consists of 5 minutes in a conventional trichlorethylene degreaser at 180°F. Stage 2 consists of immersion for 2 minutes at the boil in a 700 gallon tank containing phosphating chemicals dissolved in a special stabilized grade of trichlorethylene. A coating weight of 150 mg. per sq. ft. is produced. Stage 3 is an 850-gallon dip tank in which the parts are immersed for 3 minutes in a black satin finish trichlorethylene-thinned air-drying enamel. A dry film thickness of 1 mil. is produced.

The advantages of this technique are compactness

(Continued on page 100)

Metal Finishing Technology

A Students' Guide: 7

An Introduction to the Examination Syllabus in Metal Finishing of the City and Guilds of London Institute

Compiled by A. ALEXANDER

CALCULATION OF POTENTIAL DIFFERENCES AT A METAL-SOLUTION JUNCTURE

AN attempt has been made in the foregoing articles in this series to present a qualitative picture of the conditions at the interface between a piece of metal and an electrolyte. However, it is also possible to deal with this matter quantitatively and calculate the potential difference produced.

Before describing this calculation it is first necessary to consider the properties of the system.

When a metal is placed in a solution containing ions of the same metal, there is a tendency for the metal to go into solution. As soon as a small amount of metal is dissolved a potential is set up which prevents further metal going into solution.

The tendency for the metal to go into solution is called the "electrolytic solution pressure," and can be calculated from potential measurements for different metals. The quantities, however, obtained by these calculations are difficult to interpret because they range from 1.1×10^{43} atmospheres for magnesium to 1×10^{-36} atmospheres for platinum. Although these quantities appear unreal from the point of view of calculations, they can be used and give useful results, although they cannot really be interpreted by ordinary physical concepts. However, for the purpose of calculation it is possible to assume that the electrolytic solution pressure of a metal is a definite quantity and can be assessed.

Ions in a solution obey the gas laws, that is substances dissolved in water or other solvents, behave very much as though they were a gas. Thus pressure \times volume = temperature \times a constant.

In other words, if the pressure increases the volume decreases in proportion. If the temperature increases either the pressure or the volume or both increase. In this case, however, the pressure is not the actual pressure of the solution, that is the pressure on the sides of the vessel, as would be the case if the fluid were a gas, but the *osmotic* pressure of the particle concerned.

Osmosis is defined as the passage of a solvent through a semi-permeable membrane from a dilute to a strong solution, and the osmotic pressure

is the mechanical pressure necessary to prevent osmosis in the system. The pressure, of course, varies with the concentration of the solution, decreasing as the solution becomes dilute.

In order to calculate this pressure consider a cell divided into two halves by a semi-permeable membrane. In one half is a metal M' immersed in a solution containing ions of the metal and a suitable anion A and in the other half a second metal M^2 immersed in a solution of the same anions together with ions of this second metal. If the volume of the solutions involved is considered fairly large, small changes in the amount of metal introduced or taken from them will not appreciably effect the osmotic pressure. Let P' represent the electrolytic solution pressure of the first metal and p' the osmotic pressure of the ions in this metal in the solution and π' the potential difference at the juncture between the first metal and the solution. The potential produced at the electrode face can be calculated in the following way:—

First allow the cell to produce that quantity of electricity which is associated with the passage of 1 gram-ion of M' from the metal to the solution $M'A$. Since the solution is known to be positively charged compared with the electrode, the electric force opposes the motion of the positive charge. Accordingly, the electrical work involved is:—

$$A_1 = -n'F\pi',$$

where n' is the valence of the metal M' and F is in Faradays. Next dilute, reversibly, a volume, V' , of the solution, containing one gram-ion of M' , to a volume $(V' + dV')$. This increase in volume will cause the osmotic pressure of the M' ions to decrease to $(p' - dp')$, and the potential difference at the junction of M' and $M'A$ to change to $(\pi' + d\pi')$. The maximum work obtained from the process of dilution is:—

$$A_2 = p'dV',$$

if quantities of the second order of magnitude are neglected. Finally, pass $n'F$ faradays of electricity through the cell from right to left, causing one

gram-ion of M' to deposit on the electrode from the solution. Since, in this case, the electric force assists the motion of the positive charge, the electrical work involved is :—

$$A_3 = n'F(\pi' + d\pi')$$

Since the total work done by an isothermal, reversible, cyclic process is zero, it follows that :—
 $A_1 + A_2 + A_3 = -n'F\pi' + p'dV' + n'F(\pi' + d\pi') = 0$
 whence,

$$n'Fd\pi' = -p'dV'$$

According to Boyle's law, at constant temperature,
 $p'dV' = -V'dp'$

Therefore,

$$n'Fd\pi' = V'dp'$$

Since

$$pV' = RT$$

(where R is the gas constant), it follows that

$$n'Fd\pi' = \frac{dp'}{p'}$$

On integrating this expression,*

$$n'F\pi' = RT \ln p' + \text{const.}'$$

Since

$$\pi' = 0,$$

when

$$P' = p',$$

the constant of integration in the above equation is equal to $-RT \ln P'$. Hence,

$$n'F\pi' = RT \ln p' - RT \ln P',$$

when,

$$\pi' = \frac{RT}{n'F} \ln \frac{p'}{P'} \quad (13)$$

or

$$\pi' = \frac{2.3026 RT}{n'F} \log \frac{p'}{P'} \quad (13a)$$

Equation (13) is known as Nernst's equation.

The ratio $2.3026RT/F$ has the following values, when the gas constant, R , is expressed in electrical units (8.3) : At room temperature the value of the ratio may be taken as 0.058. Substituting this value in equation (13a),

$$\pi' = \frac{0.058}{n'} \log \frac{p'}{P'} \quad (14)$$

From the form of equation (14), it can be seen that a tenfold increase or decrease in the value of the osmotic pressure, p' , is attended by an increase or decrease in π' of $0.058/n'$ volts.

This equation gives the potential difference in terms of the osmotic pressure and electrolytic solution pressure but from a practical point of view, this is not very useful, because these quantities are not generally known. However, another equation could be obtained which gives the change in potential with the concentration of the metal

on and this is an equation which is used quite often in practice. Since the osmotic pressure of the ion varies with the concentration, the concentration times a constant can be substituted for this osmotic pressure. Taking two sets of conditions at concentration C^1 and C^2 and writing an equation for the potential in each case, then :—

$$\pi' = \frac{0.058}{n} \log \frac{KC'}{P'}$$

and

$$\pi^2 = \frac{0.058}{n} \log \frac{KC^2}{P'}$$

If one equation is subtracted from the other, we then get :—

$$\pi^2 = \pi' + \frac{0.058}{n} \log \frac{C^2}{C^1}$$

This gives the change in potential on changing the concentration from C^1 to C^2 .

This equation is used for a number of purposes in electro-chemistry. For example we may wish to find the hydrogen ion concentration (pH) of a solution. If a hydrogen electrode is considered, that is to say a piece of platinum, covered with spongy black platinum and then saturate it with hydrogen gas, we can measure the potential between this and a standard electrode. Since the potential will vary with the concentration of hydrogen ions in the solution it is possible to calculate this latter figure from the above equation by comparing the potential of the unknown solution with a solution of known hydrogen ion concentration.

Polarization

It has been pointed out that if the piece of metal is suspended in a solution containing ions of that metal a definite potential will be set up between the metal and the solution. In order to pass a current from the solution to the metal it is necessary to have a potential slightly greater than this, since a static potential, being of the opposite sign, will tend to prevent the flow of current through the system. If two pieces of smooth platinum are dipped into a solution of sulphuric acid and connected to a galvanometer and a battery, it will be found that current will not pass through them until the potential of the battery has been raised to 1.7 volts. At this potential a small current will flow for a short time but will rapidly decrease and fall to zero. If the battery is then removed and the circuit completed through the galvanometer alone the current flows in the opposite direction for a short time. What probably happens is that when the current is passed through the two platinum plates, gases are liberated at the two surfaces but are unable to get away and remain as film on the surface of the platinum plates. As soon as the

*Natural logarithms are denoted by the symbol "ln" and common logarithms by the symbol "log."

battery is removed, and the circuit completed, these two electrodes act as a primary battery sending current in the opposite direction until the gases have re-dissolved in solution as hydrogen and hydroxyl ions.

The phenomenon above is known as polarization and the electrodes are said to be polarized. This happens in many cases in practice where a force is set up opposing the current which is passed through a cell. Thus it will be found that in an ordinary system the voltage actually observed at an electrode is greater than its static potential and the additional voltage, that is the difference between the actual observed voltage and the theoretical, is termed the polarization voltage.

This fact may be due to several causes, in the first case when metal is deposited from a solution on to an electrode the concentration of the metal ions near the electrode will be reduced. As has been seen, the potential between the solution and the electrode will vary with this concentration giving what is called a concentration polarization. Thus if two pieces of copper are placed in a solution of copper sulphate and a current passed from one piece to the other it will be found particularly if the solution is prevented from circulating, that there will be an increase in the concentration of copper ions round the anode and a reduced concentration at the cathode. If the source of current is now removed and the two pieces of copper connected together, current will again be found to flow in the opposite direction which will continue to flow until the concentration of copper ions at the electrodes returns to normal.

There are, however, a number of other circumstances which will produce polarization, for instance, a film of gas which may be liberated and adsorbed on to the surface in the same way as in the case of the two platinum plates, or in some cases a layer of oxide or other metal compound may be produced. Also a time reaction may be involved in some cases a part of the change taking place at any electrode requiring a certain time and if the current density is increased considerably, sufficient time may not be available for the particular ions in question to come up to the electrode and to complete the reaction required.

Passivity

This phenomenon is somewhat similar to polarization. An electrode, usually an anode, is said to go passive when current will no longer pass through it. If, for example, a small piece of copper is put into an acid copper solution at a fairly low temperature and a high current passed from this to another copper electrode, in a few minutes the current ceases to flow and it is impossible to get current through the system. If the electrode is removed carefully, washed in warm water and put

back in the solution current will flow again for a short time. Alternately if the current density is gradually reduced a steady current may be produced.

What has happened in this case is that the electrode has polarized in a similar manner to that described previously. The copper ions leaving the electrode are unable to form copper sulphate in the solution sufficiently quickly and a layer of oxide is formed on the surface which adheres to the surface and insulates it.

A similar effect is produced by dipping a piece of iron into a concentrated nitric acid. The iron can then be immersed in a copper sulphate solution without copper depositing on it and will become practically immune to attack from various acids and corroding agents. Again what has happened is that a very thin coating of oxide has formed on the surface protecting the underlying metal.

Decomposition Voltage

Considering the case of the two platinum electrodes immersed in sulphuric acid it is only possible to get a current to flow when the applied electromotive force exceeds the back electro-motive force of the electrodes. When this happens, of course, hydrogen will be liberated at the cathode and oxygen at the anode. If a small voltage is applied to the two electrodes and gradually raised until a steady flow of current is obtained, the point at which this steady flow starts is called decomposition voltage and this voltage can be found for various electrolytes.

Over-Voltage

The decomposition voltage of an electrolyte, however, will vary with the nature of the electrodes, thus it is found that a higher voltage is required to decompose a solution of sulphuric acid between the platinum anode and a lead cathode than between two platinum electrodes. This is because more work is required to liberate hydrogen from a lead surface than a platinum surface. The difference between the observed potential required for the passage of a current at a particular electrode and the equilibrium voltage is called the over-

Table I
Metal Overvoltages

Metal	Cathode Overvoltage (Volts)	Anode Overvoltage (Volts)
Silver	0.00	
Lead	0.00	
Cadmium	0.01	0.01
Zinc	0.02	0.01
Copper	0.02	0.02
Thallium	0.02	1.68
Iron	0.03	1.88
Cobalt	0.46	0.05
Nickel	0.82	1.75

(Continued in page 100)

Overseas Review

(Continued from page 96)

reduced costs (the work is only heated once), reduced fire hazards and rapid drying of the paint film. Sludge in the phosphating section is claimed to be negligible and it will be extremely interesting to see how far this technique can be developed.

Fluid-Bed Coating⁽⁵⁾ is another coating method discovered in Germany in 1952 which, according to a survey made in early 1959, is being used by 26 American firms. In essentials, a fine plastic powder (50/150 mesh) is blown with nitrogen or air to form a uniform solids-in-gas suspension inside the coating vessel. The article to be treated is then submerged under conditions which cause the plastic to adhere. Plastic powders which have been used and recommended are low-density polyethylene, nylon 6 and 11 and some vinyls and celluloses. The advantages for the technique are complete absence of solvents, the ability to cope with complex shapes in a single pass and low cost.

A still further type of coating is the introduction by an American firm of 0.003 in. thick stainless-steel foil coated on one side with a pressure-sensitive adhesive⁽⁶⁾. This material is claimed to adhere satisfactorily at temperatures between -50 and 300°F. and has a 2-year shelf life. It is said to be extremely easy to apply and outlets envisaged are in the architectural decorative field and for signs and service plates, etc. Certainly an interesting way of cladding where a very thin layer of stainless steel is required.

Zinc Versus Cadmium

Apart from the question of cost, I have never been certain when to use or recommend zinc in preference to cadmium or *vice-versa* for corrosion protection. Beyer⁽⁷⁾ has answered this problem with particular reference to design engineers in the appliance industry. He suggests that although in general zinc will serve as well as cadmium and should therefore be used in view of its lower cost, there may be several applications where the following six special features of cadmium are of an advantage:—

1. Cadmium is more ductile than zinc.
2. Freshly plated cadmium is easier to solder than zinc.
3. Cadmium-plated screws require less torque to drive than zinc plated screws.
4. Cadmium-plated electrical contacts retain a high surface conductivity longer than zinc and are to be preferred to contact points (but not to silver).
5. Where hydrogen embrittlement is a major importance, cadmium should be used in preference to zinc.
6. For marine applications, cadmium is often preferred because of its non-crusting corrosion products.

REFERENCES

- (1) *Metal Finishing*, 1960, **58**, (12), 40-44, 47 and 1961, **59**, (1), 37-41.
- (2) *Plating*, 1960, **47**, (12), 1364-1367.
- (3) *Plating*, 1960, **47**, (12), 1368-1371.
- (4) *Ind. Finishing*, 1960, **37**, (1), 24-26, 30, 32.
- (5) *Metal Finishing*, 1961, **59**, (1), 42-44.
- (6) *Steel*, 1960, **147**, (26), 68-69.
- (7) *Plating*, 1960, **47**, (12), 1361-1363.

Metal Finishing Technology :

A Students' Guide

(Continued from page 99)

voltage. Over-voltage is usually referred to hydrogen and oxygen, although it is possible that metals also have certain small over-voltages. The over-voltage will depend not only on the nature of the electrode, that is to say the substance of which it is made, but also on the state of the surface, a highly polished surface producing a different over-voltage to a matt surface.

This over-voltage is of particular importance in the electroplating of zinc from an acid solution. It would be expected that, since zinc is well above hydrogen in the electrochemical series, if an acid solution of zinc salt were electrolyzed only hydrogen would result and not zinc. In fact however, there is a high hydrogen over-voltage at the zinc electrode and this prevents the deposition of hydrogen so that a zinc deposit is obtained from an acid solution.

Since all plating solutions are aqueous, they

Table II

Hydrogen Overvoltages of Metals and their position in the Periodic Table.

Group in the Periodic Table	Metal	Typical Overvoltage (volts)
I	Na, Cu, Ag, Au	0.35
II	Mg, Zn, Cd, Hg	0.70
III	Al, Ti	0.50
IV	C, Sn, Pb	0.45
V	Sb, Ta, Bi	0.42
VI	Cr, Mo, W	0.32
VII	Mn	0.25
VIII	Fe, Ni, Rh, Pt, Ir	0.18

will contain both hydrogen and hydroxyl ions and there will always be a tendency under certain circumstances, for hydrogen to deposit at the cathode and oxygen at the anode. The over-voltage, therefore, is of some considerable importance because it is normally undesirable for these gases to be liberated at the electrodes in any quantity. Hydrogen is often the source of pitting and may also cause embrittlement not only of the deposit but also of the underlying metal.

(Series to be continued)

THIRTY-FIVE YEARS OF OUTPLATING EXPERIENCE—2

Continued

*from page 18,
January, 1961*

A Description of Plant and Techniques at the Battersea Factory of

ATLAS PLATING WORKS LTD.

Still-tank Line

THE amount of still-tank plating undertaken at Battersea is small in comparison with that processed in the barrel shop, but even so the same high standard of finish is maintained. The tanks are situated in a shop immediately adjacent to and in fact part of the main building. Intercommunicating doors are made of rubber and eliminate the time-consuming precautions required when transporting heavy and truck-borne loads through conventional doors.

The shop has its own degreasing and pickling, wiring and jigging facilities and therefore little or no use is made of equipment in the barrel shop. Also incorporated in this building is a polishing shop and a maintenance bay.

The main bulk of the degreasing for the still-tanks is handled by a trichlorethylene degreaser made by the company from standard parts. The problem encountered here was one of depth, as most of the plating vats have deeper solutions than is normally encountered. By purchasing the

standard parts a tank of suitable depth was designed and built. Acid baths for pickling are also provided and used as required.

There are two lines of still-tanks, (Fig. 1) one for nickel and chrome and the other for nickel only which also includes one tank for the deposition of dull nickel, necessary where maximum ductility is required for after plating fabrication. Both lines are laid out along the longest dimension of the building, making the plating sequences continuous in a straight line, and leaving plenty of room either end for jigging and unjigging.

The nickel-chrome line situated on the right of the shop (Fig. 1) handles the bulk of the work here, and the sequence starts, after degreasing and pickling, with an electrolytic cleaner, either cathodic or anodic. The work is progressed through the copper, nickel and chrome tanks. The process is semi-automatic, the work being wired onto conducting shafts, and the rods moved by hand from tank to tank. On either side of the tanks are raised platforms which run the whole length

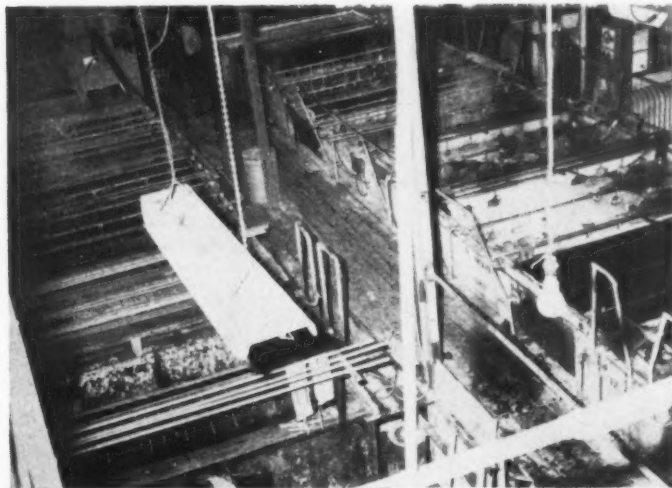


Fig. 1.—General view of two lines of still tanks.

Fig. 2.—(right) Two operators are able to transfer work from tank to tank.

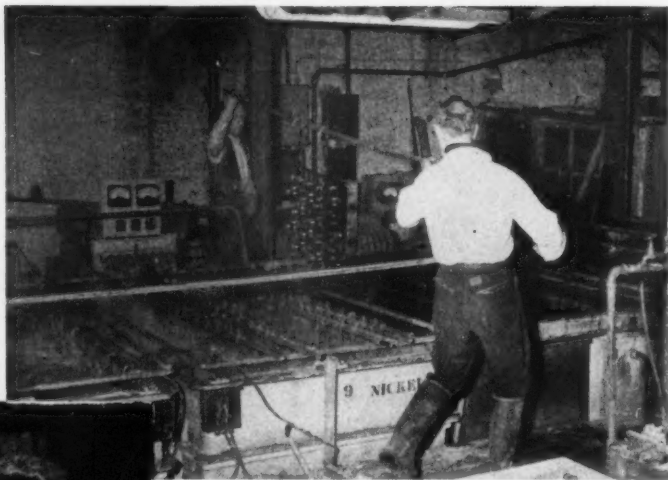


Fig. 3.—(below) Typical jigging operation.



of the line. Two operators are thus able to transfer the work effectively from tank to tank without any undue effort (Fig. 2). The platforms are also high enough to allow maintenance and minor adjustments to be made to either solutions or the tank itself without undue risks being taken. The line consists essentially of three 800-gal. glass-fibre tanks of nickel solution, and one 800-gal. lead-lined tank of chrome solution.

The second line (Fig. 1) is solely for nickel plating with a copper flash, and is therefore not so long as the first line. The plating is basically the same up to the nickel tank. The tanks in this line are smaller, 300-gal. capacity, and are the more usual rubber-lined variety. Being in close proximity with the first line, the centre platform serves both lines.

Fig. 4.—(right) Typical loads of components wired for plating.



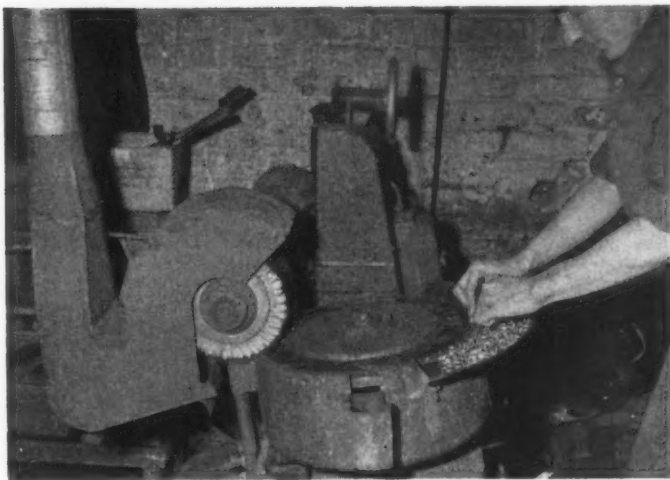


Fig. 5.—(left) Semi-automatic screw-head polishing machine.

At the top end of these lines, adjacent to the degreasing and pickling tanks, is a small section where women undertake the wiring and jiggling of components (Figs. 3 and 4). At the other end of the lines the reverse process of de-wiring is also handled by women. A fairly large proportion of the wiring is contracted out as homework, but most of it is done in the shop. Two centrifugal dryers are on hand at the de-wiring section to handle any components that require immediate drying. All polished nickel-chrome work is dried in the Trisec dryer housed in the barrel shop as it is not suitable for drying by centrifugal means. At this juncture it is worth mentioning a piece of research that Atlas are engaged on in the field of component drying. Their aim is to produce a solution having the quality of many modern detergents, into which components can be dipped and dried in a blast of hot air without tarnish or stain.

On the left, after passing through the rubber doors from the warehouse, is the maintenance shop, which handles repairs and routine work for both barrel shop and still-lines. A number of modifications are effected here to Atlas' own specifications, enabling them to experiment with proprietary equipments.

Also at this end of the shop is a section which contains a semi-automatic polishing unit (Fig. 5) enabling screw heads and other components to be finished, and six double-ended polishing lathes.

The rectifiers controlling the power supplies to the vats are all of the oil-cooled selenium type made by Westinghouse, and are arranged along the far right-hand side wall for the nickel-chrome line, and on the left of the nickel only line. Each tank has its own rectifier, which enables adjustments to be made on all individual processes in the plating sequence.

Fig. 6.—(below) The "Lift-O-Matic" plating unit. 1. Drive motor. 2. Lift mechanism. 3. Tanks for pre- and after-treatments. 4. Motor for lowering and raising main plating vat. 5. Control unit. 6. Loading and unloading station. 7. Main plating vat. Mechanism for lowering and raising main plating vat.

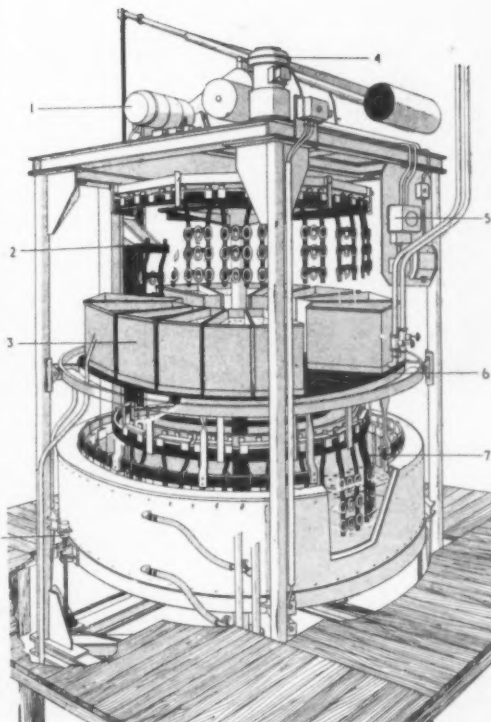


Fig. 7.—(below) This picture was taken during the installation of the Lift-O-Matic at Battersea. The control panel can be seen on the right.

Fig. 8.—(right) The Lift-O-Matic in operation showing jigs being loaded and unloaded.

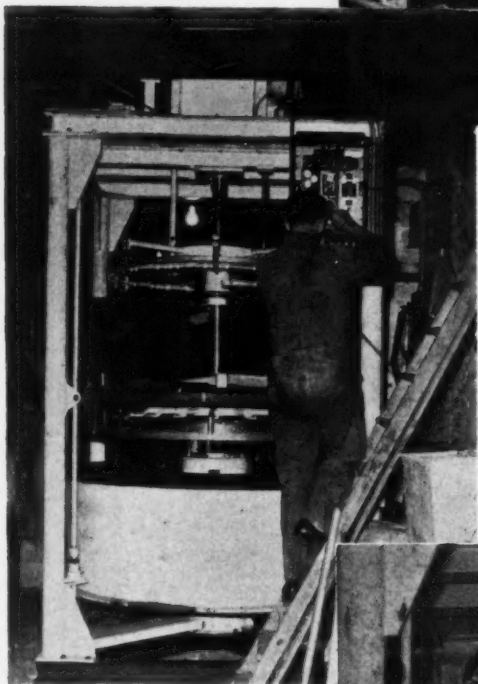
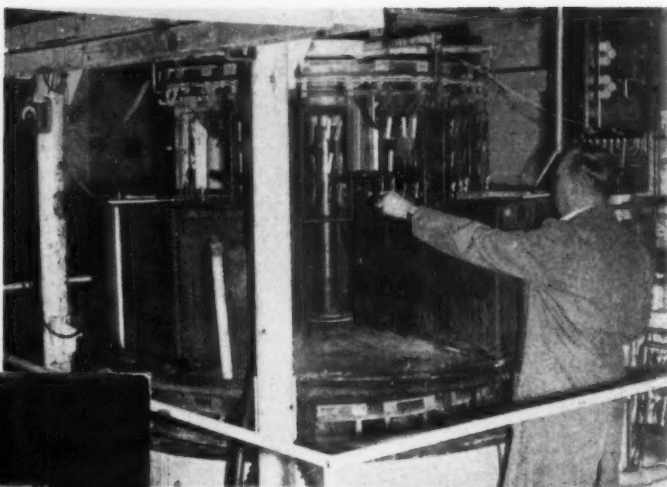
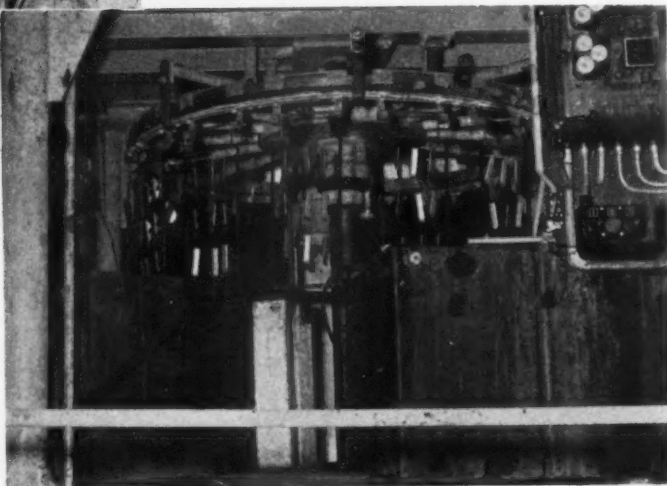


Fig. 9.—(right) Close-up of loaded jigs in pre-treatment sections.



Automatic Plating Plant

The Lift-O-Matic automatic plating unit (Fig. 6) recently installed by Atlas has been designed specifically for the smaller plater who has no need for the larger automatic plant but requires a unit more advanced than the traditional hand-operated plant. Plating-Chemie N.V., who have their headquarters in Holland, explored this and have developed this fully automatic, simply-constructed unit which claims a relatively high output for its size.

The unit makes use of the basic idea that most plating sequences can be divided into three operations :

- (a) short pretreatments.
- (b) the main plating treatment, and

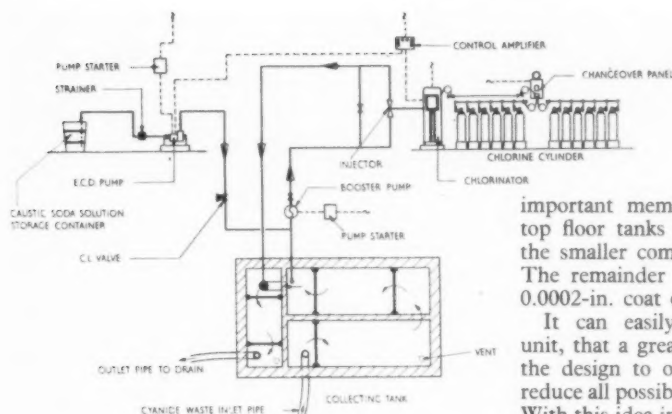


Fig. 10.—Flow diagram of effluent treatment plant.

- (c) a number of after-treatments, including drag-out rinses and swills.

The unit has therefore been designed in a circular two-tiered configuration (Fig. 7) with the pre-treatments starting on the top tier, progressing to the lower tier by means of a lift for the main plating operation and returning to the top tier for after treatments.

The top tier has fifteen separate stages, two of which are used for loading and unloading stations (Fig. 8) and one other to accommodate the lifting stage. The tanks on the top tier have a capacity of between 15 and 20 gal. and are lined with $\frac{1}{8}$ -in. hard rubber or special PVC.

The lower tank (Fig. 6) takes up the whole tier, has a capacity of 310 gal. and is used for the main plating operation.

The lift, which transports a jig from the top tier to the bottom tier consists of a section of cathode bar which fits exactly into a gap in both the top and bottom tiers. It is mechanically operated and is connected directly with the support of the top tier cathode. While the machine is in operation the top cathode bar is lifted and rotated so that when lowered again the components are immersed in the next plating solution. The interchange of jigs takes place at the end of this rotation, and the points of suspension are so arranged that at the highest position of lift the cathode bar section of the top tier exactly fits the lift section cathode bar. The rotary movement and lift is supplied by a $1\frac{1}{2}$ -h.p. brake-reduction motor, housed on a floor on top of the unit. A lift mechanism, driven by a 1-h.p. motor, is also provided for lowering the main plating tank, so that cleaning and anode removal is greatly facilitated.

The unit is constructed between four posts, a top frame and a bottom frame with the driving unit housed on a floor on the top frame. All the

important members of the construction and the top floor tanks are lined with hard rubber while the smaller components are lined with a plastisol. The remainder of the machine is painted with a 0.0002-in. coat of special Hypalon base paint.

It can easily be seen, when inspecting this unit, that a great deal of care has been taken with the design to obtain maximum simplicity and to reduce all possible maintenance work to a minimum. With this idea in mind a number of safety interruptors have been used to protect the machine against damage likely to be caused by incorrect loading. A stainless-steel frame is suspended above the first top-floor tank so that any incorrectly loaded jig touches it and automatically stops the motor. A similar device is employed to protect the unit against possible damage if jigs and components are accidentally blown off, a hazard often encountered when air agitation is employed. Another safety device comes into operation if any undue resistance is experienced by the rotary mechanism, bringing the machine to an immediate halt.

The electrical system is very simple and all operating mechanisms and relays are built into a separate housing, (Fig. 7).

A typical sequence of operations in this machine is: load; hot anodic clean; hot anodic clean; rinse; acid dip; copper strike; rinse; nickel plate; rinse; chromium plate; dragout; neutralize; rinse; unload.

Effluent Treatment

The effluent treatment plant, a flow diagram of which is shown in Fig. 10, installed at Battersea was designed by Wallace and Tiernan Ltd., and although it was decided that the plant should only deal with the cyanide content, provision was made so that the plant could, if necessary, be adapted for dechlorination and final pH correction.

Cyanide is destroyed in waste by oxidation with a basic oxidizing agent, chlorine, and alkali at a pH value of not less than 10.5. This oxidation process, now the most widely used in the treatment of cyanide wastes, is generally referred to as the 'alkaline chlorination' process. The cyanides are destroyed with chlorine to either the less toxic cyanates or completely to the non-toxic nitrogen gas and carbon dioxide, the latter uniting with the alkali to form bicarbonates.

The destruction of cyanides to cyanates, which was the problem at Atlas, theoretically requires

Fig. 11.—This photograph was taken during the excavations for the effluent-plant tanks.



2.73 parts or pounds of chlorine for each part or pound of cyanide. Actually, due to the usual presence of other oxidizable materials, the chlorine requirements may be 1 per cent to 25 per cent higher. Therefore, calculations were based on a 3:1 chlorine to cyanide ratio.

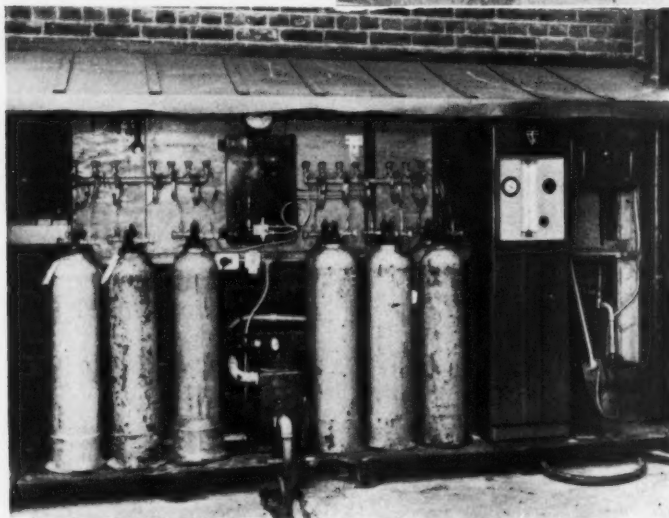


Fig. 12.—(left) Chlorine gas equipment, transfer pump and alkali-dosing pump.

(Courtesy of Wallace and Tiernan Ltd.)

The cyanide-bearing waste liquors are discharged from the factory, flow into a holding balancing tank constructed in reinforced concrete below ground, weired and baffled to prevent short circuiting. The effluent, having been balanced out, flows into a reaction tank which is built integrally with the holding tank. A quantity of the balanced effluent is picked up by a pumping unit and is passed through the injector of a chlorinator receiving a dosed quantity of chlorine gas, having first received a quantity of alkali, and then discharged into the reaction tank in such a manner that it will mix with the incoming effluent from the balancing tank. Oxidation of the cyanide takes place within this reaction vessel prior to the effluents discharge into the drains.

The unit for administering chlorine gas into the effluent is a Wallace and Tiernan 'V-Notch' chlorinator, type A.731B. This new medium-capacity chlorinator has a modern appearance, attractive styling and is built entirely from corrosion-resistant material, for which the manufacturers claim an extremely long and economical working life.

It employs the unique principle of flow control, whereby a flow of gas is dependent upon the vacuum produced by the water-pressure operated injector. The gas flow is regulated by maintaining a fixed vacuum differential and varying the size of the metering orifice, which takes the form of a variable position 'V-notch' plug and can be moved through a precisely fitting ring to vary the orifice area. The position of the plug is adjusted by means of a rack and pinion operated from a control on the front panel of the chlorinator. Adjustment is precise and smooth over a wide range and since no needle-type feed adjusters are incorporated in the design, a much finer degree of control is established.

The injector of the chlorinator is operated by

(Continued on page 107)

Atlas Plating Works*(Continued from page 106)**Fig. 13.—Close-up of alkali-dosing pump.**(Courtesy of Wallace and Tiernan Ltd).*

passing a small quantity of the effluent through the injector by means of a by-pass in the pump delivery main, running round a partially closed stop valve.

To provide the required flow of chlorine gas, two banks of six 70 lb. liquid chlorine cylinders are arranged so as to operate with one bank on line while the other acts as standby. The banks of cylinders are operated under cylinder changeover panel control whereby the standby bank is brought automatically into service when the pressure in the cylinders in use has fallen to a predetermined level. During changeover of the banks, an alarm switch gives both audible and visible notice of the changeover.

Caustic solution is injected into the effluent by means of pumping unit manufactured by E.C.D. Ltd. The pumping unit is of the type G/40/V simplex diaphragm and is so arranged that the discharge capacity is automatically controlled in proportion to the chlorine dose. This means that whenever the rate of flow of chlorine gas is adjusted the caustic injected will always be in proportion to that rate of flow.

The effluent pumped through the injector of the chlorinator is handled by a Pegson self-priming centrifugal pump type SA1. As can be seen from Fig. 12, the whole of the chlorine gas equipment plus the transfer pump and alkali-dosing pump have been housed in a very small space. The whole of the equipment is housed in a lean-to provided with removable frontage. Tubular heaters of the electric type have been installed within the housing to maintain the temperature to prevent the chlorine gas freezing, and the housing frontage is protected by an insulating wall of glass-fibre to minimize heat losses to the atmosphere.

(To be Continued)

Letter to the Editor

• Duplex nickel and continental cars

SIR, On page 15 of the January 1961 issue of your Journal my contribution to the discussion of the paper "Meeting Specifications on Nickel-Chromium Plating," was quoted in an abridged form such that the meaning of the statement appeared completely out of context.

I feel that, if meetings and discussions of this kind are recorded and printed in a journal with such standing as yours, complete care should be taken that the speakers' contributions are reported, either in full, or at least in such a manner that their statements make sense, and do not give rise to misrepresentation.

The remarks referred to were made in the course of the I.M.F. Symposium on Nickel-chromium Plating at the end of last year, where I made special

reference to the absence of the duplex nickel practice in the plating of continental cars. The important point in this connexion is the fact that the metal finishers, engaged on car work, have had no need to have recourse to double nickel deposits, because comparative results, based on exposure and service tests, do not show any advantages from duplex nickel, in cases where a heavy deposit of copper was interposed between the base metal and nickel, and where, in addition, the grinding and polishing of the base metal was carried out with care, and buffing of the copper was resorted to in order to create an exceedingly fine micro-inch finish.

On a substrate as well prepared as this, single bright nickel deposits of sufficient thickness have been found to perform every bit as well as duplex nickel deposits, and the selection of the correct type of chrome deposit has been proved to be of far greater importance in assessing total durability of plate.

Yours etc.,

J. A. BECHTOLD.

Director, M. L. Alkan Ltd.

Oil and Colour Chemists' Association

O.C.C.A. Exhibition

A description of some of the exhibits at the Oil and Colour Chemists' Association Exhibition held at the Old and New Halls of the Royal Horticultural Society in London, March 6 to 9, 1961.

THE thirteenth Technical Exhibition of the Oil and Colour Chemists' Association, formed in 1918 to further the scientific development of raw materials and equipment for the paint, varnish and printing ink industries, was held at the Royal Horticultural Societies Old and New Halls in London this month.

The popularity of this annual exhibition has increased so much that this year the organizing committee extended the exhibition by a further day and took the two halls to accommodate the larger number of companies wishing to exhibit.

On the following pages appear some details of the products displayed by some of the firms taking part.

Allied Colloids Ltd. *Low Moor, Bradford.*

Allied Colloids Ltd., concentrated on current problems frequently met in the lacquer industry and exhibits were designed to provide solutions to some of them.

The Euvinyl range of colours which are pigments predispersed during manufacture in a vinyl resin were demonstrated to show how pigments can be incorporated in organic solvent systems without grinding. These colours are particularly suitable for inks or lacquers based on PVC, and are best used by making up a 30 per cent concentrate in ethyl acetate and toluene or methyl ethyl ketone mixtures, which can then be added to the lacquer as required.

The Colanyl range of aqueous dispersed pigments were of interest by reason of their claimed high solids, good stability and low viscosity.

The age old difficulty of flotation of phthalocyanine blues was covered by exhibits showing the stabilized Heliogen brands. Finally under colours, members of the Zapon spirit-soluble dyestuff range was shown, which are stable under acid or peroxide cured systems.

Under resins, paper lacquers were exhibited, particularly those based on Suprapal BM, which

have no fire risk and can be applied by rubber rollers. This resin was also shown in NC lacquers French polish and lacquers for lino tiles. Besides its good light-fastness, low odour and scuff resistance, Suprapal BM gives high solution viscosity and has quick solvents release, both of which avoid inhibition of through-cure and any tendency to penetrate into porous surfaces.

One-pot corrosion-resistant lacquers were shown based Vinoflex MP400, a vinyl chloride copolymer. Due to the good solubility of this resin, lacquers can be sprayed without cobwebbing, while good build can be obtained without porosity. In addition the excellent resistance of lacquers based on Vinoflex MP400 to acids and alkalis was demonstrated.

Amalgamated Oxides (1939) Ltd. *Victoria Works, Dartford, Kent.*

This year, as on some previous occasions, the company's exhibit concentrated on the use of zinc dust in protective coatings with particular emphasis on Zincoli Superfine zinc dust (No. 620). This material finds widespread use abroad as well as in the U.K., and is now being produced in Western Germany by an associated company, Stolberger Zincoli G.m.b.H. of Aachen, jointly owned by Amalgamated Oxides and Stolberger Zink A.G.

The exhibit included specimens from, and descriptions of, experiments demonstrating the mechanism of the protection afforded by zinc-rich paints to iron and steel, emphasizing the importance of the protective film of basic zinc compounds deposited on immersion or exposure to the atmosphere.

Further specimens showed results from numerous exposure tests carried out with zinc-rich paints incorporating Zincoli Superfine zinc dust, with special reference to the use of these materials for marine purposes. The company has been experimenting with formulations for the production of alkali silicate zinc dust paints for several years and their use as protective coatings under marine

conditions. Examples were exhibited as great interest is being displayed at the present time on the use of these compounds for the protection of tanker holds where corrosive conditions are particularly severe.

Associated Lead Manufacturers Ltd.

Clements House, 14 Gresham Street, London, E.C.2.

The main feature of the exhibit was concerned with flame retardant paints and it was shown that the use of Timonox (Cookson's white oxide of antimony) in conjunction with a chlorine-containing polymer produces paints which materially decrease the rate of spread of flame over a surface when measured using the apparatus described in B.S. 476:1953.

Specimens demonstrating the effect of painting a number of commonly used building materials with a decorative paint were shown to illustrate that the class of a material may be raised in respect of flame-spreading by the use of flame retardant paints formulated with Timonox. Examples of gloss paints, flat oil paints and emulsion paints embodying Timonox were also on show together with photographs illustrating the progress of flame-spread measurements carried out according to B.S. 476.

Baldwin Industrial Controls

Dartford, Kent.

Of particular interest on the company's stand was a range of photometric instruments designed for the measurement and comparison of all types of black and white colour subjects. Among the instruments were:

Glossmeter. For the measurement of gloss over a wide variety of surfaces. Both incident and reflected light angles can be varied independently between 15 and 90 deg.

Colormat. An instrument for measuring and comparing the colour of surfaces or powders when illuminated by visible or ultra-violet light. It is a filter type instrument based on the principle of a balance photometer and can give an accuracy of three decimal places of C.I.E. units.

Comparator Densitometer. Designed for the measurement of turbidity and colours of paints, liquids and varnishes, in a continuous process by comparison with a standard.

Quantex Integrating Light Meter. An integrating instrument which measures the total illumination received by a vacuum-type photocell. The instrument can be fitted with a self operating device enabling it to measure light quantities over long periods. It can be used as a fadeometer by fitting filters to isolate the particular wavelength responsible for the fading.

F. W. Berk and Co. Ltd.

Berk House, 8, Baker Street, London, W.1.

The company were showing a wide range of uses for Bentone Gellants and placed particular emphasis on their ability to produce heavy-duty anti-corrosives systems based on bitumen, coal tar/epoxy and coal tar/urethane, epoxy and vinyl. Formulations and panels were shown indicating that with their help thicker coatings can be applied in one application thereby reducing labour costs. It was also shown that in many instances other advantages are gained by the use of Bentone Gellants in these systems namely, easier application, secondary plasticizing action, reduction in crazing and temperature control.

The reasons for the high and consistent linoleic acid content of Tall Oil Fatty Acid S102 from Oulu, Osaakehtio, Finland, were indicated together with examples of the use of this product in making cheaper and claimed superior alkyds and epoxy esters.

British Resin Products Ltd.

Devonshire House, Piccadilly, London, W.1.

This year, the company again presented the most recent developments in Epok surface coating resins. The main feature of their stand being a comprehensive display of the properties of primers based on Epok A.1700 water-soluble resin, under D.E.F. and other tests. Throughout the exhibition tests of wet and dry adhesion of primers based on this resin were carried out, and many new aspects of physical testing were featured.

Another section of the stand presented data illustrating the technology of emulsion paints, and demonstrated the improved resistance to dyestuffs, alkalis and fats processed by certain Epok urea and triazine resins.

An air-drying polyester, capable of being applied straight from the gun and drying hard at ordinary temperatures was also shown.

Esso Petroleum Co. Ltd.

50, Stratton Street, London, W.1.

The principal feature of the company's stand was centred around Buton resins and the wide range of applications to which they are suited. Particular attention was paid to new developments in the use of these resins in baked primers. Panels showing their high salt spray and detergent resistance were on show and the apparently superior properties and relatively low cost of these materials suggest that they should be of interest to domestic appliance and car-body manufacturers.

A number of paints based on Butyl rubber, a new entry into the surface coating field, were shown and their performance demonstrated in a

wide range of heat-resistant and corrosion-resistant applications.

Esso solvents were also featured on the stand and information was available on a wide range of aliphatic hydrocarbon solvents normally used in the surface coating industry.

Evans Electroselenium Ltd.

St. Andrews Works, Colchester Road, Halstead, Essex

The company were showing a range of their well known EEL photo-electric instruments developed for the paint, oil and colour industries. The selection included.

High Gloss Head. This instrument will detect differences in high gloss as required by method 11 of the Defence Specification 1053.

Low Gloss Head. Designed to measure gloss in the region of matt finish to low gloss. Particularly suitable for the measurement of the lower degrees of sheen.

Variable Angle Gloss Head. This instrument gives readings additional to those at the normal angle of 45 deg., enabling them to be taken from 15 to 85 deg.

Reflectometer Mark III. Designed to measure the opacity of paint films and to meet the requirements of method 12 of Defence Specification 1053.

Reflectance Spectrophotometer. For the measurement of colour characteristics of any flat surface. Particularly suitable for the evaluation of colour stability of white air-drying refrigeration paints after exposure to ultra-violet light and also to test the tendency of drift in standard colour patterns.

Spherical Haze Meter. Designed to evaluate the clarity of plastic materials and to determine the percentage of haze in a plastic sample. Conforms to the American Society for Testing Materials standard method of test for haze and luminous transmittance.

Photo-Extinction Sedimentometer. For the determination of size characteristics of powder particles in the subsieve range 0 to 50 microns.

Powder Reflectometer. This instrument is for the determination of specific surfaces of powders of very small particle size, less than one micron.

All these instruments operate in conjunction with EEL Unigalvos which are versatile galvanometers, fitted with zero and sensitivity adjustment.

Farbenfabriken Bayer Aktiengesellschaft

Leverkusen Bayerwerk.

Some new developments were displayed by this company as follows :—

Fast-to-light Desmodur N type. In isocyanate chemistry, in addition to conventional Desmodur/Desmophen combinations, the attention was drawn to the new fast-to-light isocyanate Desmodur N. Coatings on a variety of surfaces, some of them following one to two years' exposure to sea or

industrial atmospheres, demonstrated the advantages of the new non-yellowing type. The new isocyanate is also resistant to wash liquors in a boiling test.

Two new Roskydal types. While coatings based on unsaturated polyesters have so far been barred from the metal finishes field because of unsatisfactory adhesion and insufficient gloss retention, development work carried out in the technical service and development department of Farbenfabriken Bayer AG has now led to an important new product : Roskydal 650 for forced drying finishes. This type is considered by industry a valuable complement to existing classes of binding media because of its high build and excellent adhesion to metals and many plastics in conjunction with good permanent flexibility and gloss retention. Its main advantage over other classes of binding media is the possibility to apply thick films in one operation.

A new Roskydal type (Roskydal W 15), especially for coating light-coloured and bleached woods, was also shown.

A newcomer among the iron oxide pigments was the *new Iron Oxide Red Transparent 325*. It is fast to light, heat resistant and has a particle size of 0.01 micron and a specific surface of 72 sq. cm. per gm.

In the Lithoblanc field a *new zinc sulphate pigment* with about 90 per cent. ZnS offers a combination of good properties. It is micronized, has a high brightening and covering power and an excellent outdoor stability. Because of its brilliant shade it is ideally suitable for both indoor and outdoor applications. In combination with colour pigments it gives fresh pastel shades. Further advantages of this new pigment are excellent dispersibility and maximum fineness.

The Geigy Co. Ltd.

Rhodes, Middleton, Manchester.

The main theme of the Geigy exhibit was the factors affecting pigment dispersion in relation to the use of pigments in different applications. Pigment powders available in easily dispersible non-dusting forms were featured and the properties and advantages of using pigments in predispersed forms illustrated, with special reference to phthalocyanine blue.

Further information relating to the recently introduced non-toxic Irgasan bactericides and fungicides was given and progress reported on the use of the newer types of ultra violet barriers. Featured for the first time at this exhibition was Printan G, the synthetic tannic acid alternative.

Also presented as new products :

Irgalite Fast Brilliant Blue BCS. A new solvent-stable red shade copper phthalocyanine blue. The

extra redness should prove particularly attractive in paints and wherever solvent stability is essential.

Irgalite multipurpose stainers. Irgalite MPS Yellow Oxide, Irgalite MPS Red Oxide, Irgalite Fast Green MPS5, Irgalite MPS Extender. The two iron oxides and the Fast Green MPS5, based on phthalocyanine green, extend the range of five colours introduced at the 1960 exhibition and make it more widely applicable to decorative paints. Irgalite MPS Extender can be used to dilute any of the high-strength MPS colours where lower tinctorial value is required.

Irgalite Geranium RCP. A new calcium 2B toner for general use in all types of inks and paints. Its main features are the low viscosity characteristics of dispersion and its resistance to shade change in contact with water.

Irgalite Yellow BGC. A modification of the conventional fugitive type benzidine yellow specially designed for gravure inks in which it has very attractive low viscosity characteristics.

Harcure A. A solid crosslinking agent for epoxy resins designed to give systems of high flexibility, excellent electrical properties and the manufacturers claim outstanding resistance to thermal shock.

Goodyear Tyre and Rubber Co. (Gt. Britain) Ltd.

Bussbury, Wolverhampton, Staffs.

The main feature of the company's exhibit was, as last year, centred around Pliolite resins and coating systems based on Pliolite resins. The Pliolite range of resins are copolymers of styrene butadiene and copolymers of butadiene vinyl toluene. These resins are available in many ranges of solution viscosities and are suggested for interior and exterior masonry and concrete finishes, industrial, maintenance and sprayable finishes.

Pliolite AC, is an addition to the range of standard Pliolite resins and because of its long life and durability will find many uses in the exterior field.

Vitel PE 200, has been developed for solution-coating applications and is a new high molecular weight linear polyester resin. Films cast from solutions of Vitel PE 200 are clear, hard, glossy, durable and non-tacky.

Imperial Chemical Industries Ltd.

Millbank, London, S.W.1.

Dyestuffs Division. Two new fast phthalocyanine green pigments, Monastral Fast Green 3YS and Monastral Fast Green 6YS, yellower than any available until now were shown on the Dyestuffs stand. Also on display for the first time were two new Supra brand pigments, Scarlet Chrome YS and Primrose Chrome 6GS, which are claimed to have better weathering fastness in strong shades than other chrome pigments of similar hue. Methasol Copying Violet 10/BS, a spirit-soluble dyestuff

for cleaner-to-handle hectograph carbon papers was shown, while a further section of the stand included recent developments in synthetic resins and allied products for the paint and lacquer trade.

General Chemicals Division. Alloprene chlorinated rubber, an inert, non-inflammable film-forming resin was the main feature of this part of the stand. It is used as a basis for paints which must be resistant to acids, alkalis, oxidizing agents, sea water humid conditions and mould growths. It can also be used for bonding rubber to metal and is now becoming increasingly important as a modifying resin which enables synthetic rubber and other adhesives to be adapted for a wide range of industrial and domestic uses.

Heavy Organic Chemicals Division. Aromatic acids of particular interest to alkyd and polyester resin manufacturers, novel phenolic resin intermediates, adducts of unsaturated C₅ hydrocarbons and branched-chain carboxylic drier acids such as nonanoic acid among the development products shown by this Division. In the section of the display devoted to aromatic acids, isophthalic acid was of particular interest. This acid has high effective functionality does not de-esterify, gives fast polyesterification and may be used equally well in solvent or fusion processes. It produces without gelation, high molecular weight resins which have good temperature stability.

Nobel Division. The Nobel Division introduced the new Methofas non-ionic, cold water soluble cellulose ethers. They are claimed as valuable thickening, dispersing and binding agents and are used as protective colloids, adhesives and water retaining agents. Emphasis was laid on the use of Methofas HPM, hydroxypropyl methyl cellulose, in emulsion paints and in methylene chloride based paint removers.

Development chemicals on display included trimethylol propane, neopentyl glycol and 82 per cent paraformaldehyde flake.

Johnson, Matthey and Co. Ltd.

73-83 Hatton Garden, London, E.C.1.

The Johnson Matthey stand this year were showing improved pigments for anti-corrosion finishes. Initial investigations have shown that these metallic pigments have very good covering power and impart outstanding durability to finishes in which they have been used. Results achieved were highlighted and samples were available for testing.

To extend the range of cadmium sulphides and sulphoselenides, research during the past year has been concentrated on the development of new pigments based on cadmium, cobalt and titanium.

Also under development are a new highly stable cobalt-based violet pigment and a new range of green pigments based on cadmium sulphide.

Laporte Industries Ltd.

New Bond Street House, 1/5 New Bond Street,
London, W.1.

Laporte Titanium Ltd. This year's exhibition approximately coincided with the opening of the company's new technical service laboratory in Harpenden, Hertfordshire, and it was not surprising that the theme of this year's exhibit was "Service to the User." Some of the work to be carried out by the laboratory was specially featured and included, the flooding and floating of paints; the formulation of water thinned paints based on Runa RH 20; some applications of organic titanium compounds and the use of titanium nickel yellow in British standard colours.

Laporte Chemicals Ltd. The company exhibited a wide range of organic and inorganic peroxygen compounds for initiating polymerization in surface coatings, paints and allied industrial uses. Latest developments in this range of products were featured.

Research Equipment (London) Ltd.

64 Wellington Road, Hampton Hill, Middlesex.

A wide range of testing equipment was shown and included humidity, salt-spray and sulphur-dioxide cabinets, apparatus for the measurement of scratch resistance, fire retardance and abrasion resistance.

The humidity cabinet primarily for corrosion testing, consists of a copper-lined container incorporating a water tank at one end which is heated by an electrical immersion element. The temperature is raised from 42°C. to 48°C. over a period of thirty minutes and the heater automatically cut off and the temperature allowed to fall again over a period of thirty minutes, during which heavy condensation takes place on the test-pieces, fitted in trays inside the cabinet. Air is circulated by a fan which can be controlled in speed from the control panel.

The unit covers the Chemical Inspectorate (Ministry of Supply) Specification DEF.1053 Method 25, and more severe tests can be carried out by adjusting the heat input. Many and varied modifications can be incorporated, one of which is a stainless-steel lining for sulphur-dioxide testing. The manufacturers say that these cabinets can be practically tailor-made for any specification and quote as an example their use in testing plastics for mould growth.

Shell Chemical Co. Ltd.

Marlborough House, 15/17 Gt. Marlborough Street,
London, W.1.

The Shell Chemical Co. Ltd., featured Epikote resins and the company's solvents of particular interest to manufacturers of anti-corrosive paints and metal finishes.

The resins section of the exhibits included

isocyanate-cured Epikote resin/alkanolamine adduct systems; fast curing resin/PF systems; ester emulsions; resin based putties and resin solventless systems with long pot life.

The applicational dexterity of the Shell range of ketones, alcohols, Oxitol and Shellsol solvents were highlighted and special attention paid to recent developments in their use for finishes including vinyl, acrylic and polyurethane formulations.

The use of the company's amines as modifiers and emulsifiers for Epikote systems and of polyethylene glycols as intermediates in the formulation of polyester resins were also shown.

Spelthorne Metals Ltd.

38, Berkeley Square, London, W.1.

The company displayed photographs demonstrating the success under widely varying conditions of exposure achieved by a number of paint manufacturers using metallic lead pigment.

These examples were supported by roof exposure panels, one of which showed that a single coat of metallic lead primer applied to a steel panel gave a perfect protection against corrosion for a period as long as eight years.

Another part of the display consisted of exposure panels which were aged for varying periods of time before being subjected to the corrosive influence of salt-water immersion, salt spray and the humidity cabinet. These panels to some extent, provided a possible explanation as to why laboratory-type tests usually fail to correlate with roof exposures.

On the theoretical side a number of electro-potential curves demonstrating the value of metallic lead pigment as the main active constituent of paints, were shown.

The Tintometer Ltd.

Waterloo Road, Salisbury, Wiltshire.

A completely redesigned model of the Lovibond Schofield Tintometer was available on the company's stand for demonstration. Since last year's exhibition this instrument has been developed and now incorporates nearly double the illumination of the previous model thus improving the possibilities of matching high saturated and dark coloured samples. All readings made with this instrument can easily be converted in the x, y, z, values of the International system.

The fifth edition of "Colorimetric Chemical Analytical Methods" has now been completed and this well known handbook of reference was available for inspection. This edition is considerably larger than previous ones and is bound in loose-leaf form so that new tests can be inserted.

Also on show was a collection of permanent glass colour standards for use with many well known and international accepted colour scales.

(Continued in page 113)

AN interesting development in modern water cooling technique is the production of a complete packaged cooling tower small enough to be transported in a light lorry. It has been designed by Film Cooling Towers (1925) Ltd., and has a basin, shell, and splash tray made of resin bonded glass fibre, a construction which while contributing to the lightness of the unit, eliminates the necessity of protective painting.

The tower operates on the induced draught principle; the fan and motor being mounted on the canopy, expel the air from the top at high velocity. The cooling air entering at the foot at a relatively slow speed, is circulated evenly over the base area and throughout the interior of the tower. The packing is of the film flow design which provides the maximum possible heat transference in a small space. It is composed of a number of horizontal trays of parallel laths each layer being at right angles to the trays immediately above and below it. The water is discharged from spreader troughs which run along the entire length of the tower and flows down the grid packing, changing direction through 90 deg. every two inches, down the whole depth of the tower. A continuously changing film of water meets the ascending air without obstructing its course and, as no drops are formed, the loss of water by entrainment is negligible.

The internal packing which is made of impregnated timber is proof against attack by wet, dry and soft rot organisms.

The unit is supplied ready for immediate operation merely requiring to be coupled after the ground has been suitably levelled. Since the pond basin is an integral part of the tower no concrete or steel tank and foundations are necessary.

O.C.C.A. Exhibition

(Continued from page 112)

BX Plastics Ltd.

Higham Station Avenue, Chingford, London, E.4.

The main feature of the BX stand was nitrocellulose, already established in the form of cotton linters. The most recent addition to this range is dense nitrocellulose which should be of particular interest to users with handling or storage problems.

Many interesting applications for which BX terpene resins are successfully employed were shown and included adhesive and pressure-sensitive tapes and gloss water wax polishes. The technical and BX grades of camphor used extensively in the plastics and pharmaceutical industries, were demonstrated, together with the general use of BX dipentene as a solvent and anti-skinning agent for the paint and varnish industries. Its use as a solvent in rubber processing, synthetic resins and industrial cleaners and polishes is widely accepted.

WATER COOLING BY PORTABLE EQUIPMENT



Fig. 1.—General view of portable water cooler

Provision is made for anchor bolts for use when installed on a roof top or in any location where high wind forces prevail. Built-in lugs are provided for crane slings.

The packaged cooling tower can be supplied in an attractive range of self colours and requires practically no maintenance, capacities ranging from 300 to 5,000 gallons per hour.

This unit has been specially developed to meet the needs of industries requiring small-scale water cooling facilities at a moderate cost.

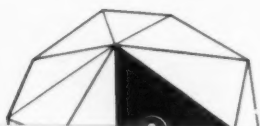
British Titan Products Co. Ltd.

10, Stratton Street, London, W.1.

The company's exhibit was mainly concerned with the effect on dispersion of improvements in Tioxide pigments, drawing attention to the wide range of pigments now available. Since the introduction by B.T.P. of refined end-treated rutile pigments, now called Tioxide R-CR and Tioxide R-HD, paint manufacturers have introduced new types of paint mills, most of which depend upon even better pigments for their effective use. It has therefore been the policy of B.T.P. to effect further refinements to their pigments so that improved paints can be made in a variety of paint mills, differing widely in their principles of operation. These differing principles demand different mill charge formulations and a special point was made at the exhibition to demonstrate the best ways to take advantage of the improved pigments. In addition to Tioxide R-CR and R-HD a full range of titanium pigments was shown.

SBSF Nickel + Plusbrite Nickel = Plusbrite Duplex

*The best formula
for a fully bright nickel plate
with maximum corrosion resistance*



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NEWS REVIEW

INTERNATIONAL GALVANIZING CONFERENCE
TO MEET IN INTERLAKEN

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Monday, 5 June. Formal opening followed by :—*Session 1*

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Session 2

(a) Works practice on general galvanizing and mechanical handling.

(b) Properties of galvanized coatings.

Tuesday, 6 June—Session 3

The welding of galvanized steel.

Session 4

The influence of bath and steel composition on the properties of galvanized coatings.

Session 5

After-treatments for galvanized steel.

Session 6

Corrosion.

Wednesday, 7 June, Thursday 8, June.

Visits to general galvanizing plants in Switzerland and to sheet tube and wire galvanizing works in Italy.

Friday, 9 June.*Session 7*

Bath heating and Control.

Session 8

The manufacture and properties of galvanized sheet.

Session 9

Questions and Answers.

Banquet in the Grand Hotel Victoria-Jungfrau.

Simultaneous translation into French, German, Italian and English will be provided at all technical sessions.

The Conference fee—£23 for delegates and £8 for their ladies, covers all social functions, travel expenses during works visits, preprints of technical papers in English, French, German or Italian (to be circulated well in advance of the Conference), and a final bound copy of the proceedings, but not hotel accommodation or meals other than the final banquet. Arrangements will include a comprehensive programme for ladies accompanying delegates.

Details and application forms may be obtained from European General Galvanizers' Association Secretariat, Zinc Development Association, 34, Berkeley Square, London, W.1.

BINK UNITS IN "STELVETITE"

THE Bink, manufactured by Bink Unit Developments Ltd., of Oldham, is a fitment for small houses where there is no space for a separate bathroom. The bath itself is situated underneath the movable sink and drainer section and is completely concealed when not in use.

Small-scale production of the Bink began a year ago. Now, with further expansion planned, a new, improved range of Binks has been developed using Stelvetite, the plastic-coated sheet steel, for the unit panelling. Stelvetite, produced by John Summers and Sons Ltd., of Shotton, Chester, is particularly suitable for the job and many advantages accrue from its use.

(Continued in next Column)

BRISTOL SIDDELEY BEST
SUGGESTION OF 1960
AWARD

MR. Ernest Hall, a leading hand in one of the plating shops at the Patchway, Bristol, Works of Bristol Siddeley Engines Ltd., was recently presented with the sum of £100 for the best suggestion of 1960. His prize-winning idea was a special spray gun for painting fir tree root slots in compressor and turbine discs. The previous method had entailed applying aluminium paint to the slots by a small brush, and spraying equipment makers who were approached said they were unable to design a suitable spray gun. Mr. Hall, however, made a gun in accordance with a design he had submitted and its use has made a considerable saving in the time required for spraying the discs.

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Mr. Hall showing his prize-winning idea to Sir Alec Coryton, Deputy Chairman (Bristol) of Bristol Siddeley Engines Ltd.



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SBSF Nickel + Plusbrite Nickel = Plusbrite Duplex

*The best formula
for a fully bright nickel plate
with maximum corrosion resistance*



SBSF is the new nickel plating bath based on PB-SF, a sulphur-free addition agent for use where maximum corrosion resistance is required.

SBSF has excellent levelling characteristics and produces a uniform semi-bright deposit of high ductility and low internal stress. This semi-bright finish can be buffed. Alternatively

a further deposit, from a Plusbrite Nickel (PB-N1 and PB-N2) electrolyte will produce a fully bright nickel plate particularly suitable for car trim and similar products which require a bright finish and good corrosion resistance. Plusbrite addition agents are easily controlled and are not removed by filtration, so operating costs are kept to a minimum.

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THE LOWEST PRICED NICKEL PLATING PROCESSES

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BORIDE, CARBIDE AND NITRIDE POWDERS FOR PLASMA-ARC SPRAYING

RELIABLE spray units now available which produce flame temperatures up to 15,000°F. with inert or non-reactive atmospheres, have extended the range of high-temperature materials which can be applied as coatings by removing the limitations imposed by chemical flame sources and, as a result, any material which does not decompose below its melting point can now be sprayed. It has been found that satisfactory coatings can be produced with carbides, borides and nitrides using plasma-arc equipment, thus enabling fuller advantage to be taken of their unusual erosion-resistant, corrosion-resistant,

high-temperature and electrical properties. The Norton Company, through their associated company in England, the Norton Grinding Wheel Co. Ltd., Welwyn Garden City, Herts. have indicated that they are prepared to offer a wide range of powders suitable for plasma spraying; to minimize powder feed problems the particle size is restricted to a narrow range, that most generally suitable being minus 150 mesh plus 325 mesh for non-metallic high-temperature materials; Norton offer powders in this and four other particle size ranges.

PAINT SALES DRIVE

A NEW sales policy for industrial finishes has been announced by Mr. N. T. Saxton of the Industrial Division of paint manufacturers, Blundell, Spence and Co. Ltd. Whereas the previous policy has been to obtain an enquiry for any type of industrial finish and then produce a suitable sample, in the future they will also market five new lines comprising hammer finishes, both quick air-drying and stoving types, suitable for electric fires and other heaters, a semi-gloss stoving enamel for electrostatic or ordinary spraying and dipping, machine tool finishes, both cellulose and synthetic, a new white stoving enamel for spray application, with a high titanium content, giving excellent coverage and gloss in one coat, and a quick-drying alkyd black, with a flashpoint over 73°F. and a drying time of 15-20 minutes.

TRADE MISSION TO IRAQ

A SMALL party of British businessmen and industrialists, which has been organized jointly by the Advisory Council on Middle East Trade (A.C.M.E.T.) and the Federation of British Industries, recently left for Iraq for the purpose of strengthening and renewing trade contacts in that country, examining the prospects of increasing trade between the United Kingdom and Iraq and assisting in the development of Iraqi economy. The mission met Iraqi Ministers and officials and Iraqi and resident businessmen in Baghdad, the Iraqi Federation of Industries and Chamber of Commerce and visited a number of industrial enterprises in Baghdad, the Mosul/Kirkuk area and Basra.

AMERICAN FIRM HONOURS EMPLOYEES

TWENTY-FOUR O. Hommel Company employees, representing a total of 340 years of service to the Pittsburgh, U.S.A., ceramic materials manufacturers, were honoured at the company's annual service pin ceremony. In making the presentation, Mr. Ernest M. Hommel, the president, commented that this was the 24th year for the awards, a custom started by his father and founder of the company, Mr. Oscar Hommel, in 1936. The ceremony took place at the company's new research centre.

Vitreous Enamel in Metal Treatment Lecture Course

A LECTURE entitled "Vitreous Enamelling" was delivered by Mr. G. F. Keep, Sales Manager of Escol Products Limited, recently at the Kingston-on-Thames Technical College, Surrey.

The audience consisted of representatives from various engineering and allied industries who were attending a course on "Metal Treatment." The course covered subjects on stove enamelling, electrolytic polishing, anodizing, etc., and this was the first occasion that such a course had included vitreous enamelling in the syllabus.

The lecture created a great deal of interest and it is considered that this subject will be included in future years.

Following the lecture, the Vitreous Enamel Development Council's film "It's Glass," was shown, together with many coloured slides illustrating the activities of Stewart and Gray Limited at home and overseas in the field of vitreous-enamelled steel panels for architectural purposes.

PLASTIC COATINGS ON SHOW

A MONG the products displayed at the Leipzig Spring Fair held on March 5-14, 1961, was a series of plastic coatings by the Plastics Division of Telcon (The Telegraph Construction and Maintenance Co. Ltd.) including thermo-plastic sheeting, extruded in thicknesses from 0.020 in. to $\frac{1}{8}$ in., thermo-plastic powders, which are applied by a simple dip-coating process, Telcothene tubing, for the conveyance of cold water and a variety of chemical solutions. Telcothene-coated papers and laminates for the packaging industry, and Telstic, a synthetic heat- and pressure-sensitive adhesive.

Congress of European Federation of Chemical Engineering

THE first part of the Third Congress of the European Federation of Chemical Engineering will be held in London from June 26, 1962 on the occasion of the Chemical and Petroleum Engineering Exhibition at Olympia. The major item in the programme is a three-day meeting organized by the Institution of Chemical Engineers on the subject "Interaction between Fluids and Particles." Suggestions for papers for inclusion in the programme are invited by the Institution of Chemical Engineers and titles and brief descriptions should be sent to the general secretary, 16, Belgrave Square, London, S.W.1, not later than April 30, 1961.

THE ROLE OF MANAGEMENT IN INDUSTRIAL RELATIONS

FULL details of the first International Conference to be held at Linden Hall Hotel, Bournemouth, April 21-23, 1961, of the Institution of Works Managers, 196, Shaftesbury Avenue, London, E.C.2, are now ready.

The Conference is open to any person from either the United Kingdom or overseas who is seriously interested in the problems of works management, industrial relations and productivity.

Social activities are provided for those attending the Conference and their ladies.

Those interested should write to Mr. George J. West, F.C.C.S., General Secretary of the Institution of Works Managers, 196, Shaftesbury Avenue, London, W.C.2.

NEW FACTORY FOR ORGANIC BRIGHTENERS

THE rapidly expanding use of organic brighteners for producing electrodeposits without the laborious polishing required with conventional matt nickel deposits, and the fact that the organic chemicals used in the Efco-Udylite nickel brighteners are highly specialized materials not available on the open market, have resulted in the decision of the Electro-Chemical Engineering Co. Ltd. to build at their Woking, Surrey, factory, a complete plant for the production of raw materials for six of their Efco-Udylite nickel brighteners, in order to ensure adequate supplies.

The equipment consists of a number of stainless-steel jacketed reaction vessels, rubber-lined purification tanks and rubber-lined intermediate and bulk storage tanks with rubber-lined inter-connecting pipe-work. The brighteners are manufactured in the stainless-steel reaction vessels which are fitted with glass condensers for reflux distillation operations; on completion of the reaction, the crude products pass into the rubber-lined purification tanks where they are treated, purified and then filtered to the intermediate storage tanks, where they are held until they have been approved by laboratory analysis and plating tests,

after which they are pumped to 8,000-gal. bulk storage tanks; when required they are pumped to further storage tanks whence they are dispatched into containers for despatch.

The plant is housed in a new brick building designed by Cambell Gifford and Morton Ltd., who were the consulting engineers for the whole project; the floor is acid-resistant and the internal walls are glazed to a height of 8 ft.; a comprehensive fume extraction system has been installed to remove fumes from the tops of all condensers, vessel openings and purification tanks and all the electrical equipment and fittings are of a flameproof type.

1st INTERNATIONAL CONGRESS ON METALLIC CORROSION

THE 1st International Congress on Metallic Corrosion, will be held at Imperial College, London, S.W.7., from April 10-15, 1961. During the Congress a total of 84 papers will be presented by authors from Great Britain, U.S.A., India, Hungary, Rumania, Germany, Poland, Canada, U.S.S.R., Norway, Czechoslovakia, Finland, Japan, France, Belgium and Italy.

Preprints of the papers are now being sent to all who have registered for the Congress. The procedure at the meetings will be that authors will give a brief introduction of their own papers and will be allowed time to reply at the end of the discussion. In most cases the two or three papers forming one session will be discussed together.

The programme will also include four plenary lectures :-

"Chemical and Electrochemical Behaviour of Metals at Passivation Ranges," by Prof. Y. M. Kolotyrkin, on Tuesday, April 11, at 9.30 a.m.; "Radiotracers as Applied to the Study of Metallic Corrosion," by Prof. P. Lacombe, on Wednesday, April 12, at 9.30 a.m.; "The Advancing Frontiers of Corrosion Science," by Prof. H. H. Uhlig, on Thursday, April 13, at 9.30 p.m., and "Factors Deciding Between Active

Corrosion and Protective Film Formation," by Dr. U. R. Evans, on Friday, April 14, at 9.30 p.m.

Membership is open to all interested persons and the fee of £5 is payable to the 1st International Congress on Metallic Corrosion, 14 Belgrave Square, London, S.W.1.

RECTIFIER PRICES REDUCED

FOLLOWING recent reductions in the prices of their silicon diodes Westinghouse Brake and Signal Co. Ltd., have now announced substantial reductions, amounting in some cases to 50 per cent, in the prices of Trinitor silicon controlled rectifiers.

In addition, a new range of Trinitors, type CS32, with current ratings of 16 amperes and voltage ratings of 25-400 volts has been introduced and supplements the existing CS31 25 ampere range.

It is planned that larger and smaller sizes of Trinitors will be announced later in the year and these, together with existing types, will provide a complete range of silicon controlled rectifiers.

LAPORTE INDUSTRIES ACQUIRE CUPOLA MINING CO.

LAPORTE Industries Ltd., of New Bond Street House, 1-5, New Bond St., London, W.1, announce that they have purchased from Head Wrightson and Co. Ltd. the whole of the issued capital of The Cupola Mining and Milling Co. Ltd., for an undisclosed price.

The Cupola company is engaged, principally, in the treatment of fluorspar and barytes, and Laporte intends to meet the rising demand for acid grade fluorspar by expanding production at the flotation plant at Stoney Middleton, Derbyshire which has recently been installed by Head Wrightson and Co. Ltd.

The operations of the Cupola company will be integrated with those of Glebe Mines Ltd., another Laporte subsidiary engaged in similar operations in the same area.

REWARDS FOR KENT APPRENTICES

MANY apprentices of George Kent Ltd. received awards presented by the chairman, Commander P. W. Kent, R.N., at the firm's annual apprentice prize-giving and exhibition of work held recently at Biscot Road Works, Luton. Guest speaker for the occasion was Mr. W. F. Stephenson, B.Sc., F.R.I.C., principal of the Luton College of Technology. In his address Mr. Stephenson emphasized industry's growing need for qualified technical specialists and therefore the great importance of theoretical studies, but also made reference to a recent Government White Paper outlining the parallel opportunities available to those more suited to specialist careers of a practical nature. The varied selection of apprentices' work on display provided ample evidence of both theoretical knowledge and skilled craftsmanship.

Chemistry Exhibition

THE sixth international chemistry exhibition and conference on chemical science which was to be held in June, 1962, is now to be held from April 25 to June 1962 inclusive at the Centre National des Industries et des Techniques (C.N.I.T.), Rond-Point de la Défense et Puteaux-Paris. Applications for further details should be addressed to the general secretary, 78 Rue Saint-Dominique, Paris VII.

TECHNICAL and INDUSTRIAL APPOINTMENTS

Mr. J. F. Douglas, M.Sc. (Eng.), A.C.G.I., D.I.C., A.M.I.C.E., A.M.I. Struct.E., has been appointed head of the department of mechanical engineering at the **Borough Polytechnic**, Borough Road, London, S.E.1. in succession to Mr. G. L. H. Bird, who recently assumed an industrial appointment. Mr. Douglas was formerly principal lecturer in the department of engineering.

Mr. S. Watson has been appointed Northern regional manager of the **Darlington Insulation Co. Ltd.** and will be responsible for supervising and co-ordinating the work of the company's branches in the North of England and in Scotland. Mr. A. W. D. Pullar has been appointed Southern regional manager with similar responsibilities for the company's branches in the Midlands, South of England and Wales.

Mr. W. G. J. Appleton, M.I. Mech.E., M.Inst.F. has been appointed a director of **Stordy Engineering Ltd.**, Cumbria House, Goldthorn Hill, Wolverhampton.

Mr. John C. Pipkin has been appointed a director of the **Thermal Syndicate Ltd.**, Wallsend, Northumberland; he will also continue in his capacity as company secretary.

Four new directors have been appointed to the board of **Fletcher Miller Ltd.**, a member of the Castrol Group of Companies. They are J. R. Bickerton, Chief Chemist at Fletcher Miller's Hyde (Cheshire) Plant, J. Birchenough, Works Manager at Hyde, R. A. Miller, North London Divisional Sales Manager, and S. V. Tilley, Senior Technical Representative for the Midlands and South Wales.

G. Arnold Hart, of Montreal, President and Chief Executive Officer of the Bank of Montreal, has been elected a director of **The International Nickel Co. of Canada, Ltd.** He fills the vacancy caused by the death of Edwin G. Baker, Chairman of The Canada Life Assurance Company.

George Kent Ltd. have appointed Mr. Rodney Kent deputy chairman, and Mr. Walter May assistant managing director of the company and Mr. John G. Vaughan, F.C.A. (managing director of the Charterhouse Finance Corporation) as a director.

Mr. F. R. Creed and Mr. K. Reiser of **Lewis Berger (Great Britain) Ltd.** and Mr. W. G. Green of the **Keystone Paint and Varnish Co. Ltd.** have been appointed to the board of **Lewis Berger (Great Britain) Ltd.**

Metal Pretreatments Ltd. announce that Mr. L. A. Parkes (lately of the **Pyrene Company Limited**) (Metal Finishing Division) has joined their London staff.

Mr. Frederick A. Lesser (Deputy Chairman and Managing Director of **Borax (Holdings) Limited**) has been appointed to the board of **Hardman and Holden Ltd.** Mr. Lesser's appointment follows the recent acquisition of **Hardman and Holden** by the **Borax Group**.

Mr. J. W. Haig-Ferguson, M.A., A.M.I.Mech.E., A.M.I.E.E., A.M.I. Prod.E., has recently been appointed Managing Director of **R. & J. Beck, Ltd.**, 68-71, Mortimer Street, London W.1., (one of the **Griffin & George Group of Companies**) manufacturers of optical instruments for surveying, industry, education and research.

It is announced that Mr. R. Lewis Stubbs, director of the **Zinc Development Association**, has been appointed director-general of the **Lead Development Association** and of the **Zinc Development Association**. As such, he will be responsible for the work of both Associations and will represent them at international meetings. Each association will, however, continue to function separately and general managers for both are to be appointed.

It is announced that Mr. H. F. Spencer (managing director of **Richard Thomas and Baldwins Ltd.**), has accepted appointment as **President of the British Iron and Steel Research Association**, in succession to the late Sir Charles Bruce-Gardner.

SYMPOSIA AT BOROUGH POLYTECHNIC

TWO one-day Symposia have been arranged by the Division of Metal Science of the **Borough Polytechnic**, Borough Road, London, S.E.1 for the summer term of these sessions. Details are:

I. *Symposium on "Welding of Rarer Metals."* Thursday, 20th April, 1961 morning and afternoon.

1. Electron beam welding.
2. Welding of beryllium.
3. Welding of uranium.
4. Welding of titanium.
5. Welding of zircaloy 2.
6. Welding of tantalum, niobium, molybdenum and tungsten.

II. *Symposium on "Internal Stresses in Electrolytically Produced Coatings and their effects on the Properties of the Basis Metals."* Thursday, 6th July, 1961, morning and afternoon.

1. Internal stresses and their measurement.
2. Internal stresses in hard chromium and heavy nickel deposits.
3. Internal stresses in bright nickel deposits.
4. Internal stresses in rhodium and platinum metal deposits.
5. Internal stresses in electroforming and electrotyping.

CHANGE OF NAME

L. VAN der Hoorn's Chemisch-Technische Industrie N.V., Utrecht-Holland, announce that its name has been changed to **Harshaw Van Der Hoorn N.V.**

This change has resulted from closer and more extensive co-operation between the firm and the **Harshaw Chemical Company** of Cleveland, Ohio, U.S.A., a company from which they have had exclusive licence rights for its plating processes on the Continent since 1948.

FORTHCOMING MEETINGS

March 20
Institute of Metal Finishing (London Branch). "Zinc Plating from the Pyrophosphate Bath," by U. F. Marx and D. Povey, at Northampton College of Technology, St. John Street, London, E.C.1. 6.15 p.m.

March 21
Institute of Metal Finishing (South-West Branch). "Rectifiers in the Metal Finishing Industry," by D. Ashby, at the Royal Hotel, Bristol. 7.30 p.m. (Afternoon visit

to Westinghouse Brake & Signal Co. Ltd., Chippenham).

March 24
Institute of Metal Finishing (Sheffield and North East Branches). "Duplex Nickel and Crack-free Chromium for Improved Corrosion Resistance" by T. E. Such, at the Grand Hotel, Sheffield. 7 p.m.

March 28
Institute of Metal Finishing (South West Branch). Open Forum at the Assize Courts Hotel, Bristol. 7.30 p.m.

SPRAYING POLYURETHANE FOAM

THE Aerograph-De Vilbiss Co. Ltd., Sydenham, London, S.E.26 recently demonstrated their new "Foam-in-Place" equipment developed for spraying rigid polyurethane foam made to a special formulation by the Baxenden Chemical Co. Ltd.

Until the development of the new spraying technique there have been two methods of producing foam:

(1) Machine mixing, using special and necessarily expensive equipment for the production of foam sheets or blocks.

(2) Batch mixing in buckets (using hand or electric stirring).

In either case it is necessary to use some form of shuttering or battening to retain the foam in position.

In some instances the older methods will continue to remain the most economic method of foam production, but a large number of applications particularly lend themselves to this new simplified spray system.

Some of these applications were shown during the demonstration which included a quick-fire spray insulation of a large section of steel plate, a roof interior, a complex but

typical arrangement of service pipes, a ventilation duct and storage tank.

Metal and plastic panels used in cars, boats and planes were also sprayed to show the anti-drumming and good strength qualities possessed by this foam as well as its outstanding property as an insulant.

Another interesting application was illustrated by the internal lining of a packing case for the dual purpose of preventing the entry of moisture and also to absorb shock and so avoid damage to the contents.

The gun used has two spraying heads built into one casing, the two fluids used to produce the foam being mixed outside the gun, i.e. immediately on emerging from the nozzles. Other than the gun the remainder of the equipment, viz: two pressure feed tanks are standard with stainless-steel fluid passages and fittings. Also required is an air transformer. The spraying equipment is simple but special protective helmets must be worn by the operatives. The sprayed foam has very high insulating properties, good strength, light weight and is impervious to attack by a wide range of corrosive environments.

WATER TREATMENT EXHIBITION

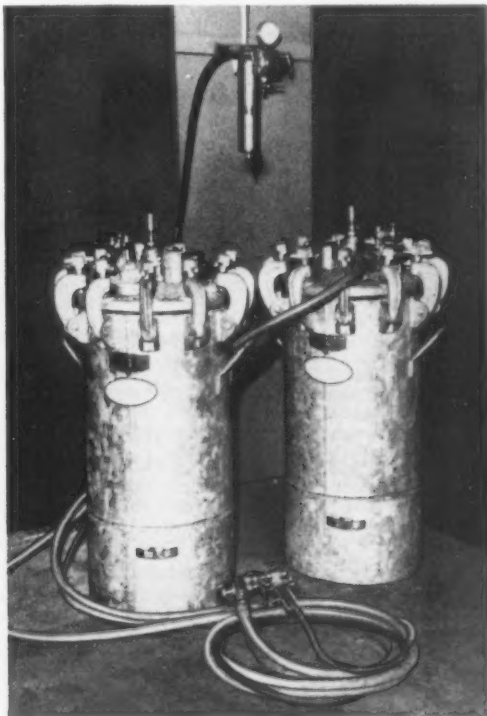
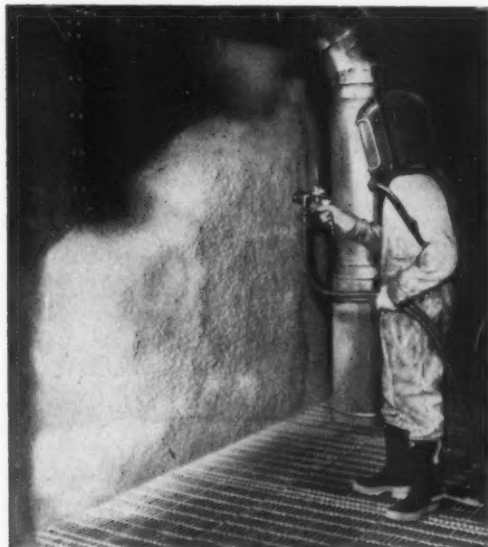
THE second Effluent and Water Treatment Exhibition and Convention will be held at The Seymour Hall, London, W.1., from October 31 to November 3, 1961 and will be larger than the first show held last year. This growth reflects an industry which has progressed through communal and industrial expansion and which comprises two complementary divisions.

Industry is having to pay greater attention to water treatment and water recovery and technical developments due to this demand and to modern industrial progress have been rapid. New methods of water supply, water supply treatment techniques, advances in industrial water softening and treatment, and developments in the reclamation and re-use of water, are all contributing to the saving of process water in industry. A concomitant result has been increased industrial efficiency and savings in process chemicals and equipment cost.

The organisers are Thunderbird Enterprises Ltd., 140 Cromwell Road, London, S.W.7.

(Right) The new equipment for spraying the foam.

(Below) Steel wall of a chemical storage container receiving polyurethane protective coating.



Corrosion Science Society

THE second Symposium of the Corrosion Science Society will be held on April 6-7, 1961 at the Battersea College of Technology, and will follow the same general lines as the meeting held in April, 1960.

The proceedings will be kept as informal as possible, so as to encourage discussion and debate. No discussion will be published. The talks and papers to be given will be concerned with very recent work and with research still in progress.

The provisional programme consists

of four technical sessions and fourteen papers.

Membership of the Symposium is open to any professionally qualified scientist or technologist working in the general field of the corrosion and protection of metals. Application forms for membership of the Symposium, which must be returned duly completed before March 29, 1961, may be obtained from Dr. T. P. Hoar, Department of Metallurgy, Pembroke Street, Cambridge and Dr. L. L. Shreir, Battersea College of Technology, Battersea Park Road, London, S.W.11.

Maintenance Conference

THE first national maintenance conference and exhibition will be held at the Central Hall, Westminster, from November 13 to 16, 1961. Among the subjects to be discussed on the fourth day is "Corrosion and new materials available to maintenance engineers" by Dr. J. E. Garside, M.Sc. (Tech.), Ph.D., F.R.I.C., F.I.M., F.Inst.F., principal of the Borough Polytechnic. Further details should be obtained from the conference organizer, National Maintenance Conference and Exhibition, 109-119 Waterloo Road, London, S.E.1.

Metal-Finishing Plant Services Extended

ALBRIGHT and Wilson (Mfg.) Ltd., announce an important agreement with Hanson-Van Winkle-Munning of Matawan, New Jersey. A & W will now be able to call on American experience in the design of automatic plant for electroplating, chemical polishing and anodizing. This agreement means an extension to the existing range of plant which A & W provide to operate their specialist metal finishing processes, notably PHOSBRITE chemical polishing solutions and PLUSBRITE addition for nickel and silver plating.

A & W engineers are now completing the installation of a large automatic chemical polishing and anodizing plant for a Midlands company. This plant has been designed to meet the needs of greatly increased production and will be in operation shortly.

CHANGE OF ADDRESS

KABI (Electrical & Plastics) Ltd. announce that their Byng Road offices closed on February 28, and all future correspondence should be addressed to Kati Works, Cranborne Road, Potters Bar, Middx.

UNITED KINGDOM CZECHOSLOVAK TRADE

THE Board of Trade announce that agreement has now been reached with the representatives of the Czechoslovak Ministry of Foreign Trade about quotas for Anglo-Czechoslovak trade in 1961.

The quota lists make provision for Czechoslovakian purchases during 1961 of about £5.6 million of United Kingdom goods including machinery, chemical plant, chemicals, plastics, motor cars, motor cycles and textile manufactures. The quota lists also provide for the issue of United Kingdom import licences for Czechoslovak goods up to a total of about £8 million. This is additional to the trade in goods which can, under United Kingdom import licensing regulations, be imported from Czechoslovakia and other countries without a specific import licence.

CHANGE OF NAME

THE Mond Nickel Company, Ltd., an affiliate of The International Nickel Company of Canada, Ltd., announces that its name has been changed to The International Nickel Company (Mond) Limited.

In announcing this change, the Chairman, Mr. Ivon A. Bailey, said that it did not involve any change in the Company's organization or in its business activities. The Board, in consultation with The International Nickel Company of Canada, Ltd., the parent company, took the view that the change of name would, in addition to indicating the international nature of the Company's activities, serve to identify it more closely with the Canadian company and the United States affiliate, The International Nickel Company, Inc.

Selective Plating Saves Lead Time for Atomic Submarine

THE use of advanced brush-plating technique saved several months of lead time recently for the atomic submarine, U.S.S. Patrick Henry, in which galvanic action was creating a serious problem in the compressed-air valves which control ejection of each Polaris missile. The removal of the valves from the submarine at its home port and shipping them to the manufacturer who built them, would have meant a delay of several months, and the problem was overcome by following the technique of plating in place, without tanks or vast quantities of expensive electrolyte. Marlane Development Co. Inc. of New York City and Metachemical Associates, Inc. (Forest Hills, N.Y.) were consulted on the corrosion problem and knowing that 25 per cent or more of indium imparts exceptional resistance to salt-water corrosion, these engineers suggested plating affected areas of each valve with an alloy of tin and indium. Using plating equipment and engineering assistance supplied by Marlane, Metachemical began work on 10 of the Patrick Henry's missile launching valves which were removed to a barge alongside and placed on rotating sheaves to facilitate manipulation of plating tools. An area of approximately 750 sq. in. on each valve was plated with the tin-indium alloy to an average thickness of about 3 mil. and the throat of the valve received a 2-mil. layer; threads inside this throat were flash-plated. A mobile power pack was used to convert 220 v. a.c. line current from a dockside outlet to d.c. and a continuously-variable voltage regulator was set to provide optimum current density (up to 5000 amp. per sq. ft.) for rapid alloy deposition. Three leads were connected to the rectifier; a cathode, clamped to the workpiece, and two anodes, to which the special plating styluses were attached. The stylus tips, machined from graphite in an oblong spatula shape, were covered with absorbent cotton, dipped into a solution containing either plating alloys or cleaner as required, and rubbed gently on the valve surface. A finely graduated amp-hr. meter allowed the operator to control the amount of metal deposited to within 0.0001 in. The plating was carried out at 20 to 25 v. d.c. at amperages varying from 40 to 45 over a contact area of approximately 6 sq. in. The total operation occupied 3½ weeks.

Latest Developments **in** **PLANT, PROCESSES AND EQUIPMENT**

Conveyorized Automatic Spraying Machine

FIG. 1 shows a conveyorized automatic spraying machine produced by Alfred Bullows and Sons Ltd., Long Street, Walsall, Staffs. Each basic unit consists of a conveyor track, a spraying station comprising one spray gun, a gun traverse motion and brackets and a down-draught exhaust system. Apart from the air required for spraying purposes, power is provided by two electric motors; one drives a gearbox *via* a 5-speed step cone pulley, which in turn, through a series of shafts and cams drives the conveyor chain, operates the gun motions and also the automatic spray gun operating valve. The extent of the gun motion is determined by the profile of the appropriate cam, of which a standard range is available. The length of spraying time is infinitely variable by means of adjustable cams. Compressed air is required to operate spray guns and valves. The unit can be fitted with 2-in., 3-in., 4-in or 6-in. pitch chain in which the workholders are fitted and as a standard has 25 ft. of chain, which can be extended either when supplied or at a later date if required. The conveyor is in constant motion and guns, when spraying, follow the work target, thus reducing inertia problems and eliminating chain make up devices. Automatic spray guns are rigidly mounted on the gun cylinder arms which are hydraulically

powered *via* gearbox master cylinders and when it is required to change to articles of varying sizes, adjustment is quickly and easily effected by interchanging or adjusting cam settings to cover motion and spraying time.

Accurate changes to predetermined spraying angles are made simple by the incorporation of calibrated gun arms and mountings and if the hydraulically operated gun motion is jammed or impeded, a relief valve in the system allows for overloading and no damage is sustained; the hydraulic system also automatically re-adjusts itself without disturbing the gun settings. The down-draught exhaust system carries the paint-laden air down to an easily removed castor-mounted separator and the exhaust air is then taken up and out to atmosphere. The basic machine includes one gun motion and brackets, 16 spindles, one dry separator and exhaust hood, air hose and valves. The machine can be fitted with a paint-saving device which automatically signals when workholders are loaded or otherwise and prevents unloaded workholders from being painted; it can also be supplied with 25 ft. of chain or a floor mounted conveyor for transportation to an unloading station where air drying materials are used, or a stoving oven, either gas or electrically heated.

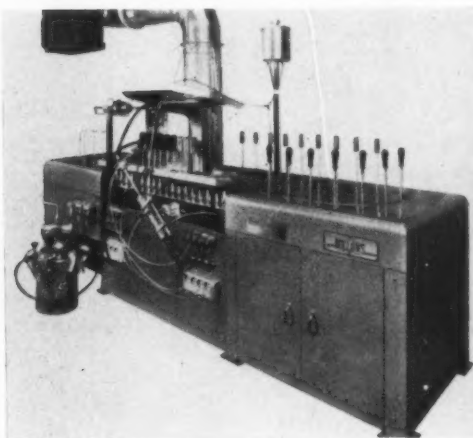
Liquid Coating with Elastomeric Properties

A LIQUID coating having elastomeric properties is announced. This product, selling under the registered name of Texseal through Vicsteels Ltd., 16 Northumberland Avenue, London W.C.2., is a recent development of the Chemical Products Division of the Dunlop Rubber Company, and is based on Hypalon synthetic rubber, a product of E.I. Du Pont de Nemours and Co. Inc.

The properties offered by Texseal result from the outstanding properties of Hypalon, a chlorosulphonated polyethylene, which has been formulated with various other ingredients. Principal among these properties are chemical and ozone resistance and hence an important field of application for Texseal is that of the corrosion protection of chemical plant and structural steelwork, particularly in marine installations. Texseal also has good flame resistance and is suitable for continuous service at temperatures up to 250°F. Because of the oxidation resistance of the base polymer pigmented Texseal exhibits good colour retention.

(Continued in page 122)

Fig. 1 Automatic spraying machine.



It can be satisfactorily applied to a variety of substrates such as concrete, steel fibreboard, wood and rubber with good adhesion between the coating and base material.

The application of Texseal is similar to that of other paints in that it can be brushed, sprayed or applied by dip and spread coating. The build and coverage per coat of Texseal depends on the nature of the base material, type of loading and solvent system. Normally, however, this is about 2 mil. with a coverage of 150-250 sq. ft. per gallon. When sprayed, the conventional type of lacquer or enamel spray equipment is used. For correct spraying characteristics the solids content is lower than that customarily used for brushing. After application the film of paint dries quickly and simultaneously commences to cure. This can be accomplished at either room temperature (which takes a few days) or at elevated temperature, viz: 250°F. (occupying a few minutes). Whatever the temperature of cure the resulting film is both tough and flexible.

The applications are numerous. It can be sprayed on to foam or fibre board to give a brightly coloured, decorative finish, it can also be applied to wood as a trim and shutter paint or for boat decks. It has been successfully applied over natural and synthetic rubbers, although care must be taken to ensure that the substrates contain no migratory plasticizer or staining material or the Texseal will become discoloured. A major suggested use is as a chemically-resistant maintenance paint for plant and structure-work subjected to a corrosive environment.

Electric Measuring and Control System with Two-Wire Working

A NEW electric measuring and control system with true two-wire d.c. transmission has been announced by Honeywell Controls Ltd., Greenford, Middlesex. Described as fully integrated instrumentation, the equipment, which is of original design embodying modular principles, is known as the Elektrik Tel-O-Set system.

Direct current transmission of the signal at 4-20 milliamps is used along a pair of wires that also carry the 24-volt d.c. power supply. There are no field power connexions and shielding of the transmission wires is not required.

Suitable for any of the usual industrial process control duties, the Elektrik Tel-O-Set system provides many modes of control including, 'proportional plus reset plus rate action' (Fig. 2).

The basic system comprises a transmitter, a 5½-in. by 6-in. receiver-controller and a valve operator. The variety of standard alternative units is considerable and includes circular scale as well as strip chart controllers, simple recorders, millivolt-

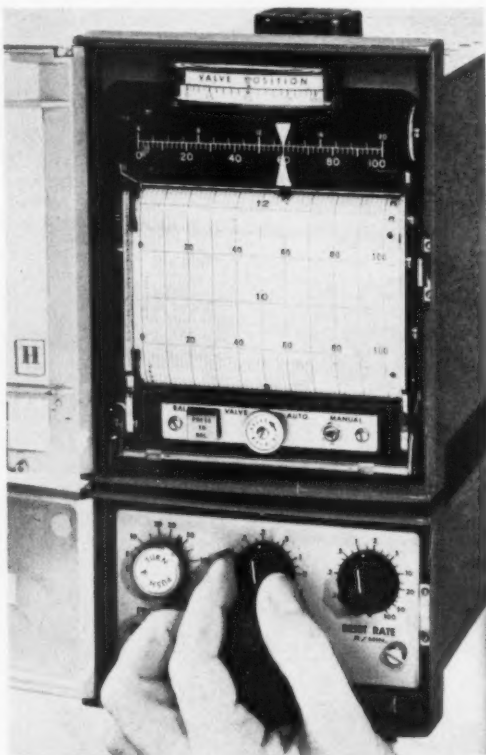
to-current transmitters, process-pressure-to-current transmitters, differential pressure-to-current transmitters, transducers for standard pneumatic-to-electric signals and *vice versa*; additionally, the control unit with the Tel-O-Set recorder may be arranged for front-of-panel or back-of-panel adjustment. All these units are fully transistorized.

All field units operate on the force-balance principle and operate in ambient temperature of -40°F. to 150°F. The recorder instruments have a 6-month ink supply, daily chart tear-off and 30-day rewind. Process and external electrical connexion to field-mounted transmitters are isolated from inside the case for convenience in maintenance.

The system will find its applications in chemical, petroleum, electricity supply, nuclear steel, water treatment, and other industries and research. Honeywell Controls Ltd., are to supply their first big scheme of this kind for the 720-mile northern Indian pipeline for Oil India Private Limited this year.

(Continued in advert page 23)

Fig. 2. Electric measuring and control system



Explosion-Proof Blendor

BY the development of the Waring explosion-proof blendor motor base, the explosion hazard which may occur when mixing certain volatile liquids and organic materials, it is claimed, has been entirely eliminated. This high-speed blendor motor base, (Fig. 4) which mixes at speeds of 8,000 or 16,000 r.p.m., is being marketed in the United Kingdom prior to later manufacture in Britain, by the Waring Division of Winston Electronics Ltd., Shepperton, Middlesex, on behalf of the Waring Products Corporation, New York, a sister subsidiary of the Dynamics Corporation of America.

Because of the manufacturing plans being carried out, servicing facilities are immediately available, since there will be no delay in the supplying of spare parts, should they ever be required, as often happens with imported equipment.

The main cause of fire and minor explosions when inflammable liquids and solids are mixed, is through the vapour in the immediate atmosphere becoming ignited from the arcs of the electric-motor brushes, or when the mixture is accidentally spilt.

Designed to be used with the Waring Pyrex glass containers and the SS-510, of approximately one-quart capacity, but not the CB-4 1 gallon container, the EP-1 Waring blendor base and motor is a *totally sealed* unit which has a Class 1, Group D Rating of the Underwriters' Laboratories of the U.S.A.

The Waring EP-1 is sold as a blendor base only,

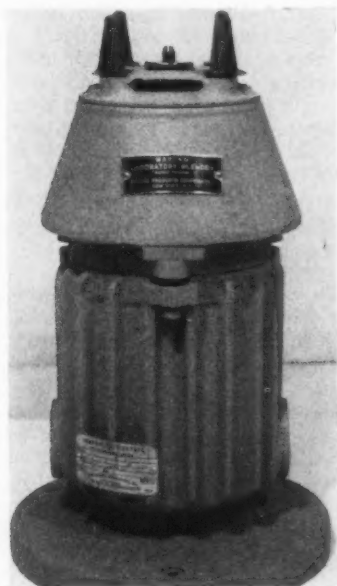


Fig. 4
Explosion-
proof
blendor

because most laboratories and factories liable to experience explosive or ignitable atmospheres have a master explosion-proof switch. However, the switch is available on request.

The model EP-1 for the British market is wired for 230 volts. The power 1/5th B.H.P., and the motor has two speeds: 8,000 and 16,000 r.p.m. free-running. The ball-bearing motor is life-time lubricated.

Epoxy Flooring Composition

TRETOL Epiflor, a new flooring composition has been developed by Tretol Ltd., for "difficult" factory floor areas. This material is a combination of special resins and aggregate which will adhere strongly to all floors. It is claimed to give a coloured, non-slip topping $\frac{1}{8}$ -in. thick, resistant to chemicals, oils and acids, and to have exceptional abrasion resistance and to withstand extreme hard wear by foot traffic, trolleys and trucking.

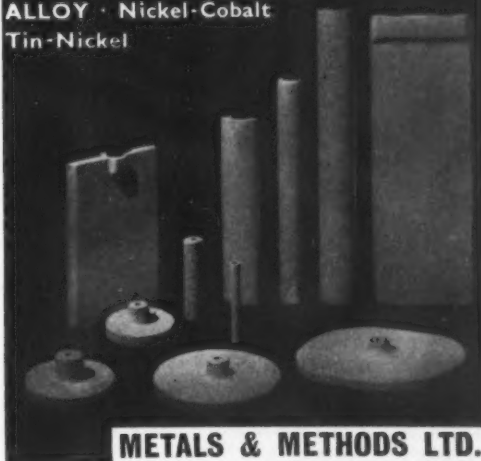
The material is especially suitable for use in chemical plants, plating shops, pickling shops, laboratories, and phosphating shops where the floors are attacked by corrosive substances and oils.

Full technical data can be obtained from the manufacturers Tretol Ltd., Tretol House, The Hyde, London, N.W.9. Telephone: COLindale 7223.

(Continued in editorial page 124)

HIGH QUALITY ANODES for ELECTROPLATING

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ALLOY · Nickel-Cobalt
Tin-Nickel



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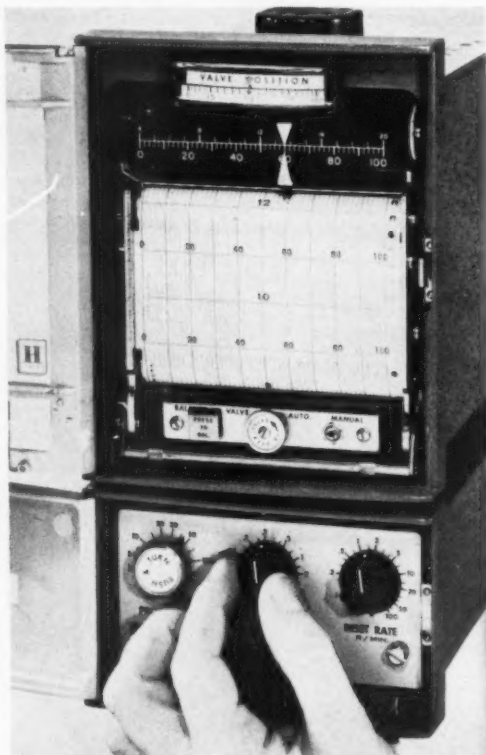
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The material is especially suitable for use in chemical plants, plating shops, pickling shops, laboratories, and phosphating shops where the floors

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Tin Anodes

Controlled Feeding of Diamond Compounds

A NEW micrometer-controlled syringe known as the Hyplicator, (Fig. 3), has been introduced by Engis Ltd., Gabriels Hill, Maidstone Kent, for the accurate metering of their Hyprez grinding and lapping compounds. These compounds are made from diamond particles between 1/10 micron and 90 microns in size, subdivided into 12 separate grades, and permanently suspended in a variety of special pastes. Between them they cover the whole range of cutting and finishing processes on soft, hard and very hard materials. They are used in preparing metallurgical specimens for the microscope, where the cleaner cutting action of diamonds over other abrasives prevents surface constituents in the metal from being distributed.

Surfaces brought to a high finish in this way are resistant to atmospheric corrosion since they contain no pores or crevices in which moisture could lodge. Since they might be damaged by some of the products of corrosion, notably crystalline copper sulphate or verdigris, which could result from the use of a metal applicator gun, the body of the Hyplicator is made of moulded nylon, with a threaded nylon shaft which engages with a knurled micrometer screw in the top of the barrel. The shaft is connected to a neoprene plunger whose base has been given a greater radius of curvature than the nozzle cup into which it descends. This ensures that every vestige of compound is forced into the centre of the cup and down the nozzle as the syringe empties. The nozzle fitting can be removed and attached to a freshly loaded syringe, so that none of the compound is wasted.

Rubber Lining

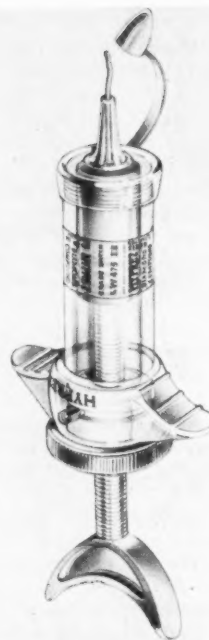
AN industrial rubber lining material that cold bonds itself to metal and other surfaces with field-applied cement has been developed by The Goodyear Tire and Rubber Company, at Akron, Ohio (U.S.A.) When utilized in industrial applications, the natural rubber covering, called Jade Green Armabond, is claimed to provide complete protection against impinging abrasion and most inorganic salts, alkalis and acids.

Through its specially compounded tie gum backing, the natural rubber lining may be cold bonded to a wide variety of surfaces, including metal, fabrics and other rubber compounds.

Field application of the new lining material requires only cleaning of the surface to be covered and spreading of cement before the rubber is placed. The chemical cure resulting from the action of the cement is said to give adhesion far in excess of common adhesive cements.

The new lining material is available at present only in the United States in gauges from one-sixteenth to one-half inch and in 48-in. widths.

Fig. 3.—Micro-meter-controlled syringe for diamond compounds.



One-dip Cadmium Conversion Process

THE Hanson-Van Winkle-Munning Co. of Church Street, Matawan, New Jersey, have produced an inexpensive single dip chromate conversion coating process for cadmium—Chem-Rite C-55, which the makers claim, enhances the brightness of the cadmium deposit, produces a clear chromate surface and is easy to operate; no subsequent leaching is necessary as with some other cadmium bright dip treatments. The chief use for Chem-Rite C-55 will be as a protective coating for hardware and other cadmium plated products that require long shelf life without discolouration and loss of brightness; it can be used with any bright cadmium process.

Anti-Corrosive Liquid Metal

STEWART Wales, Somerville Ltd., Calderbank House, 99 Brownside Road, Cambuslang, Glasgow, supply an anti-corrosive liquid metal alloy, "Galvalloy," which consists of a compound of anodic metal particles—99 per cent pure metal—suspended in a plastic anti-corrosion medium, and can be applied by brush or spray. The metals separate upon application into two distinct parallel layers of high purity metal having different electro-potentials, the lower being a galvanic coating to protect the ferrous surface from rust and the top coat to protect the other from oxidation by weather exposure.

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BONDERITE 700
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and Pylumin

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The International Nickel Co. (Mond) Ltd.

requires a

DEVELOPMENT OFFICER

for work in connection with THE ELECTRODEPOSITION OF NICKEL. Candidates should have had a sound scientific and technical training with preferably some years' practical experience in the electroplating industry. An intimate knowledge of this industry both from the manufacturing and plating sides would also be a distinct advantage.

Pension and assurance schemes are in operation and, in appropriate cases, assistance can be given with housing.

Apply, giving full particulars of qualifications, experience, age, salary required etc., to :—

The General Manager, Development and Research Department, The International Nickel Co. (Mond) Ltd., Thames House, Millbank, London, S.W.1.

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Britain's leading manufacturers of housewares invite applicants for the position of :—

PLATING DEPARTMENT SUPERINTENDENT in their north west factory

The Ideal Applicant will :

1. Preferably be aged between 35-45 years.
2. Be capable of controlling and training a mixed labour force of 110 persons.
3. Be experienced in modern plating methods on both manual and automatic units.

A complete control of laboratory and maintenance is exercised which will leave him free to concentrate on production, but his practical background as a plater will ensure that quantity is not achieved at the expense of quality.

To the right man salary is open. Extremely favourable contributory pension scheme in operation. Assistance given in moving household.

Applications, which will be treated in strict confidence should contain details of experience to date and present salary, and should be addressed to :—

Personnel Officer, The Prestige Group Ltd., COLNE ROAD, BURNLEY

SITUATIONS VACANT—Cont.

REQUIRED by leading plating supply house—development chemist, to take charge of control laboratory and pilot plant. Excellent opportunity for capable and conscientious man with experience in all aspects of electrodeposition. Full particulars to Box No. R.B. 240.

SALES REPRESENTATIVES required by Electroplating Supply House. Areas to be covered are (i) Midlands (ii) Scotland. Applicants should be 23-28 years of age and preferably have some experience of the electro-plating trade. Applicants for the Midland area should reside in or around Birmingham and for the Scotland area, in or around Glasgow. Connections firmly established with great potential for expansion. Salary, Commission and Expenses paid, and a Car will be provided by the Company. Apply in the first instance in writing to Box. No SR. 239.

PLATING SHOP CONTROLLER. A vacancy exists in a large light engineering factory for a man to control a new Plating Plant engaged on high quality precision component finishing. The person envisaged should have a varied background of industrial plating preferably with some chemical qualification and several years practical experience in this field. The situation commands a salary of not less than £1,100 p.a. initially, plus Staff status and superannuation and in view of the importance of this post, advancement to the right capable man is assured. The age limits preferred are 33-45. Write in first instance to Box. No. PS4639, A.K.Advtg., 212a Shaftesbury Ave., London, W.C.2.

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"ENGINEERING FIRM REQUIRES financial interest in small plating works to enable them to get some priority on their plating requirements, at present in the region of £15,000/£20,000 P.A. Please write to :—Box No. E.F.241."

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FOR SALE—Little used B.V.B. Vapour Blast Cabinet internal 26 in. x 26 in. x 16 in. complete with 15 h.p. motorised compressor, and air receiver. L. Solloman Ltd., Beaufort Street, Manchester, 3. BLA. 4571.

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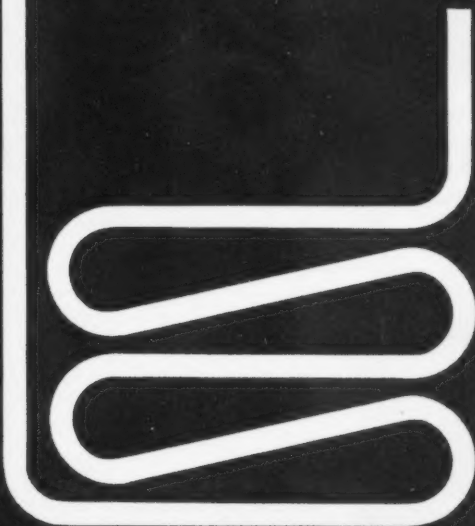
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WE MAKE FIBREGLASS TANKS, VESSELS and BINS for corrosive fluids, oils and chemicals, please ask us to call or phone Lewes 2149. Reinforced Plastic Structures (Lewes) Ltd., Watergate Lane, Lewes, Sussex.

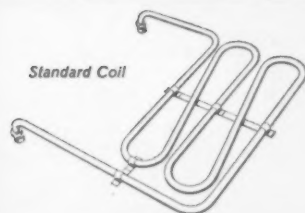
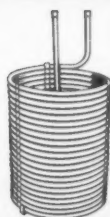
FIT THEM— FORGET THEM!



Marston titanium heating coils for really long trouble-free life

You can forget about corrosion troubles when you fit Marston titanium heating coils to your plating baths. Available in a standard size ex stock, easy to install, light and strong as well as outstandingly corrosion-resistant, they enable you to cut your maintenance costs dramatically. Heating costs go down, too, because the coils retain full heat-transfer efficiency throughout their life.

The Marston Standard Titanium Coil is suitable for use in baths of 2-3 ft. depth, and you can fit one, two or more according to the capacity of the bath. The diameter of the tube is 1 in., the wall thickness 0.036 in., the length 18 ft. 6 in., and the weight—only 4½ lb.! Write now for fuller details.



Standard Coil

**MARSTON
EXCELSIOR LTD.**

*(A subsidiary company of
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FORDHOUSES, WOLVERHAMPTON



It pays to consult Marston about other items of titanium equipment: non-standard heating and cooling coils, process solution baths, bath linings, heat exchangers, agitators, pump linings and components, and pipework.

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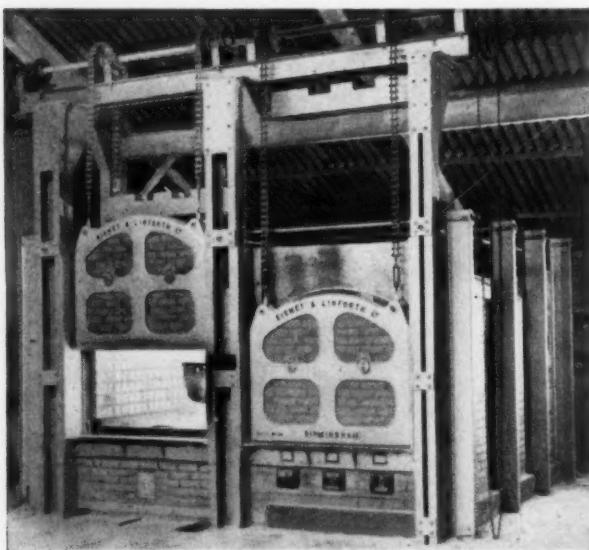


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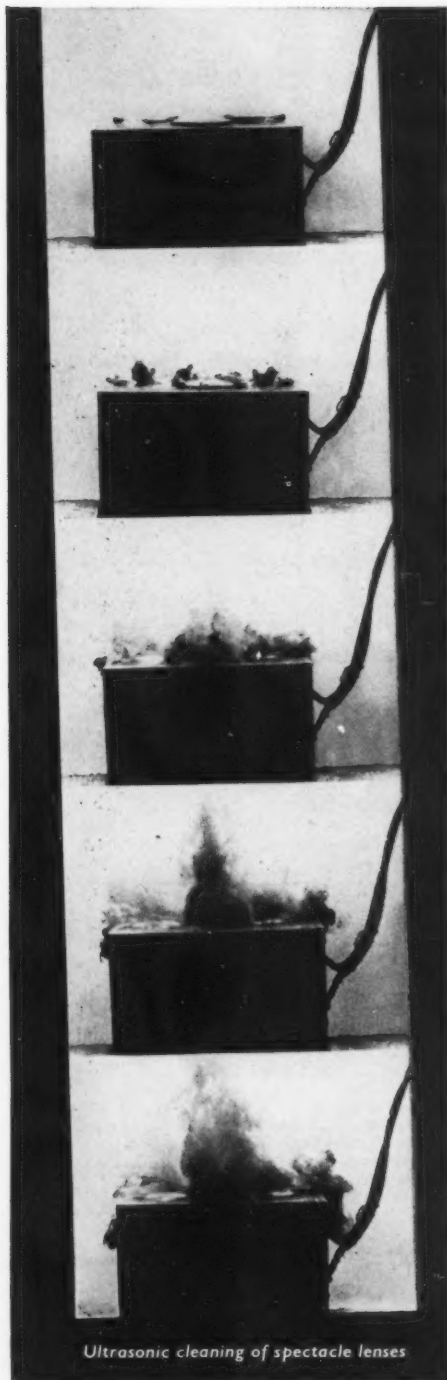
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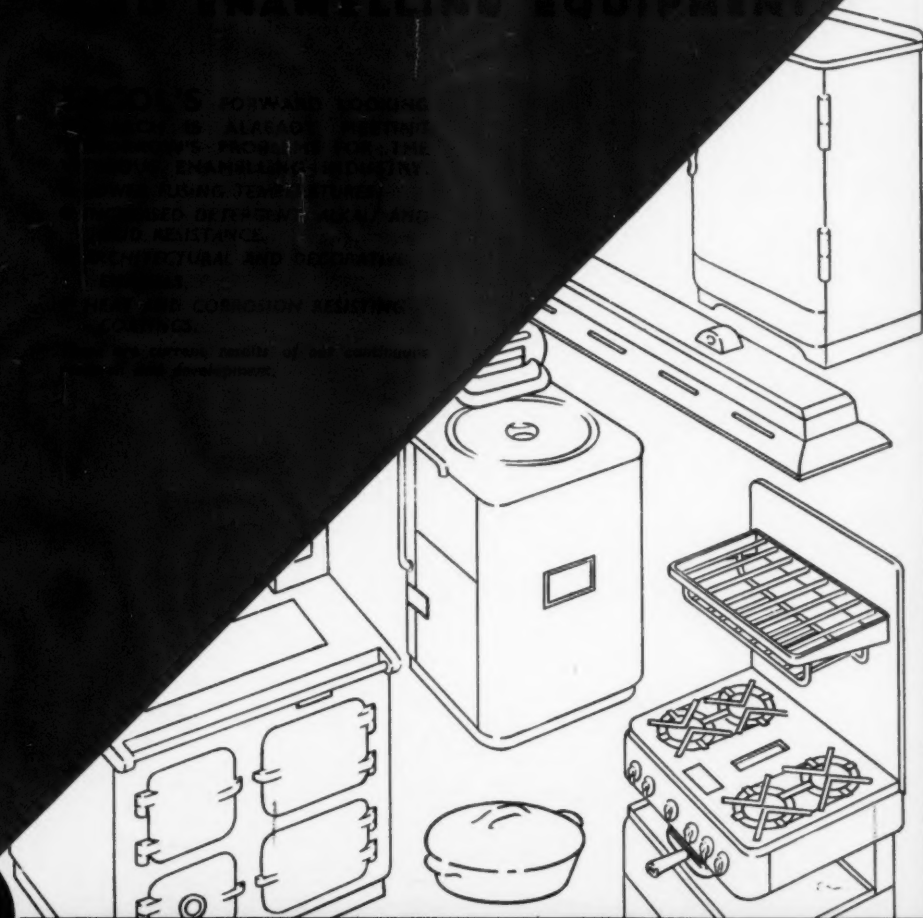
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